MAR 13 1922

Popular Science

Found MONTHLY

That New Box of Tools Cost Friend Wife a Trip to the Movies, but—

What You Can Make at Home with Tools (Page 75)

300 Pictures of New Inventions

13c a day soon buys an Oliver Typewriter—latest model

FREE TRIAL

No Money Down

Before you realize it you have this splendid Oliver paid for. And you get to use it right away—while you pay.

To begin with, you save $50.50 on the price, for we now sell the standard $100 Oliver for $49.50 cash. Or you save $45 if you pay the installment price of $55. It is our latest and best model, the No. 9. The finest product of our factories.

We are able to make these great savings for you through the economies we learned during the war. We found that it was unnecessary to have great numbers of traveling salesmen and numerous expensive branch houses through the country. We were also able to discontinue many other superfluous sales methods.

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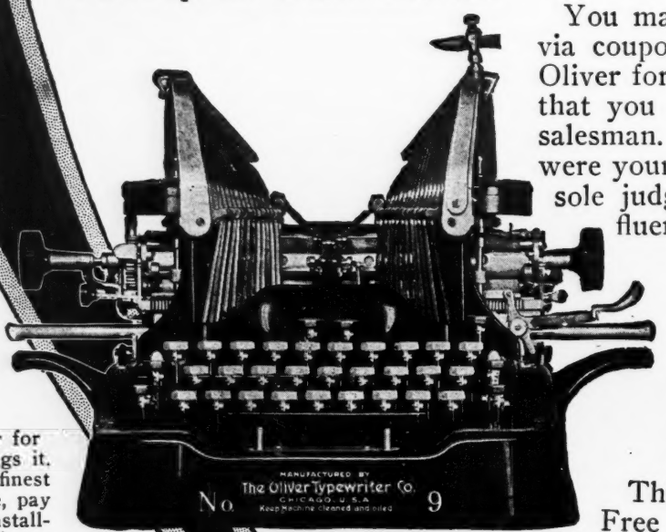

You may buy direct from us, via coupon. We even send the Oliver for five days free trial, so that you may act as your own salesman. You may use it as if it were your own. You can be the sole judge, with no one to influence you.

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Let us send you the Oliver for Free Trial. The coupon brings it.

If you agree that it is the finest typewriter, regardless of price, pay $49.50 cash for it, or $55 on installments—$3 after trial, then $4 per month.

If, after trying it, you wish to return it, we even refund the outgoing transportation charges. So the trial does not cost you a cent. Nor does it place you under obligations to buy.

Our new plan has been a tremendous success. We are selling more Olivers this way than ever before. Over 900,000 Olivers have been sold! Oliver popularity is increasing daily.

This, the Oliver 9, has all the latest improvements. It is noted for its sturdiness, speed and fine workmanship. It is handsomely finished in olive enamel and polished nickel. If any typewriter is worth $100, it is this Oliver, for which we now ask only $49.50, after its being priced for years at $100.

Mail the coupon for EITHER a free trial Oliver or further information. Be your own salesman and save half. This is your great opportunity.

Canadian Price, $79

The OLIVER Typewriter Company
1104 Oliver Typewriter Bldg., Chicago, Ill.

Now $49.50

This coupon brings you a Free Trial Oliver without your paying in advance. Decide yourself. Save half.

Or this coupon brings further information. Check which you wish.

THE OLIVER TYPEWRITER COMPANY,
1104 Oliver Typewriter Bldg., Chicago, Ill.

☐ Ship me a new Oliver No. 9 Typewriter for five days' free inspection. If I keep it I will pay $55 as follows: $3 at the end of trial period and then at the rate of $4 per month. The title to remain in you until fully paid for. If I make cash settlement at end of trial period I am to deduct ten per cent and remit to you $49.50.
If I decide not to keep it, I will ship it back at your expense at the end of five days.

My shipping point is.....

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

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Popular Science Monthly

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Tank Tractor Becomes Earth Digger

"Sword Beaten into Plowshare" as Artillery Machine Is Converted into Lightning Excavator and Automatic Loader

THE snorting steam shovel now has a successful rival—the army artillery tractor that once plowed through barbed wire and crawled on its continuous tread over seemingly impassable obstacles.

The unhalting tank has been converted into a versatile tractor excavator that will "buck" any hill of soft earth and load the dirt automatically into waiting trucks in less time and at lower cost of operation than its steam predecessor.

As the tank tractor "bucks" a hill, the digging bucket scoops up a load of earth, then is hauled up an incline to dump its contents

One Man Can Run It

One man can control the motor driven excavator, directing its course by throwing out and locking one of its tracks and driving on the other. So effective is this method of steering that the machine can practically turn a complete circle in a little more than its own length.

At the nose of the tank hangs the digging bucket, which buries its cutting lip and prongs into a pile of earth as the tractor bucks the material to be excavated. To dump its load, the bucket slides backward and upward along an inclined track of steel rails mounted above the tractor.

To raise the load in this manner, the operator starts a winch that hauls in a wire cable. This cable, attached to the upper end of the bucket, first rotates it half a revolution, picking up a full load of earth, then drags it up the inclined track and dumps the contents automatically into a waiting truck by reversing the bucket at the upper end of the track.

The winch is then thrown out of gear, permitting the wire to unwind freely. The bucket falls back into position with its cutting ends forward, slides down the sloping rails, and strikes the pile again, picking up the next load.

Since the capacity of the bucket is one cubic yard, and a complete cycle of digging and unloading is performed in two minutes, the machine excavates very rapidly. Its output is said to be from 100 to 300 tons a day, depending on the nature of the material that is being excavated.

Power is derived from a four cylinder gasoline engine of 35 brake horsepower. To protect the machine from falling stones and debris, the runway over the engine and the driver's seat is armed with steel plates one eighth of an inch thick. Side curtains can be fitted further to protect the driver against rain.

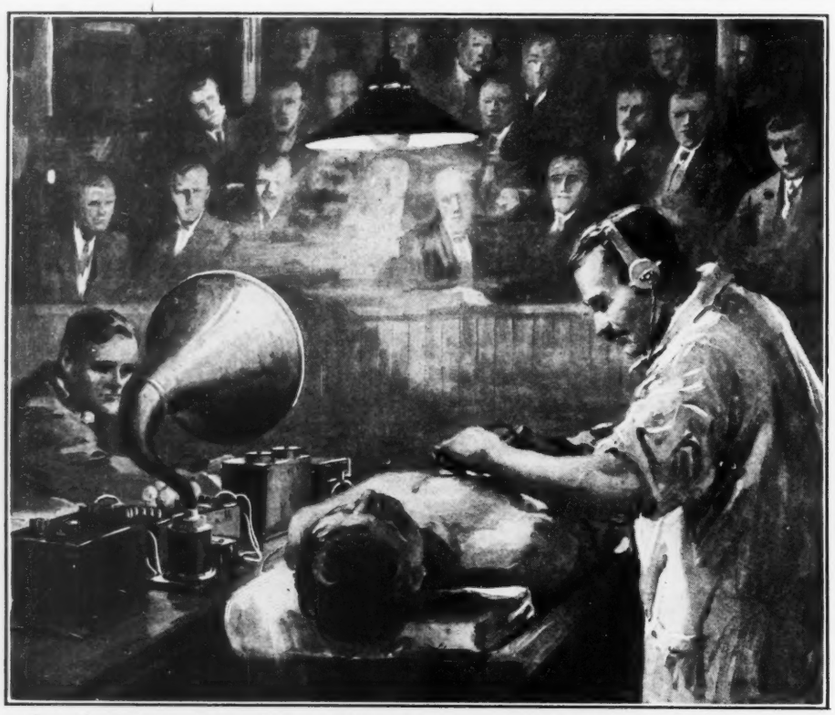
The bucket automatically empties its load into a waiting truck, then slides down the rails again to scoop up the next load

How Bucket Is Hoisted

The hoisting apparatus is driven from the engine by double roller chains and double friction clutches arranged directly on the barrel of the winch, permitting the barrel to revolve freely when the bucket is lowered. The hoisting ropes are arranged on each side of the bucket so that when the container is tipped and emptied, the material has an unobstructed path. These operating ropes run over segmental guides and under the bucket, equalizing the pull on each rope.

[The ingenious tank excavator described in the foregoing article is but one of many instances of the manner in which England has been salvaging her abandoned war material, converting it to peacetime use. Meanwhile, we have permitted thousands of war machines to rust away, or have disposed of them for a song. Perhaps it is not too late, even now, for American ingenuity to profit by this example.—*The Editor.*]

Heart and Lungs Now Voice Their Ills by Phonograph



Sounds of distress from heart and lungs are amplified and broadcasted, like a speaker's voice, so that they can be heard throughout a large room

FROM phonographic records of feeble heart and lung sounds, greatly amplified, doctors soon may be able to diagnose symptoms of diseases without even seeing their patients! Records may be submitted to medical authorities in distant cities or abroad for expert study and examination.

All this, it is said, will be made possible by the recent invention of a recording mechanism which intensifies the faint sounds of the heart and lungs until they can be heard plainly, even throughout a large lecture hall. Credit for the work goes to Dr. F. L. Hunt, of the Bureau of Standards, and Dr. M. J. Myres of the United States Army.

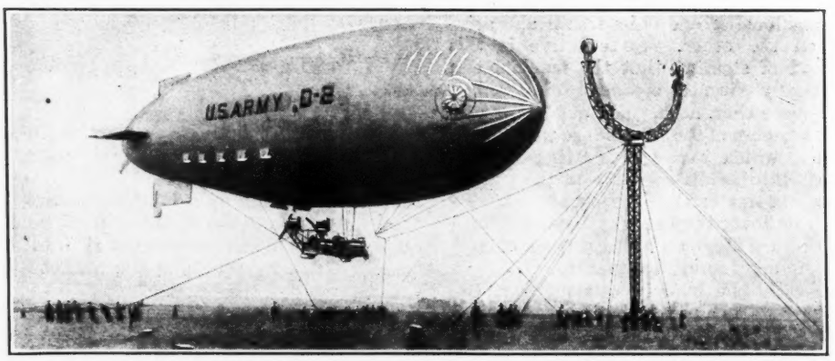
The invention is an amplifying system like that used in broadcasting a speaker's voice. An ordinary carbon telephone transmitter is employed as a stethoscope and the currents generated by heartbeats or lung sounds are amplified and transferred to a telegraphone using steel wire as a recording element.

This wire runs between two electromagnets actuated by current from the amplifiers. As it passes the poles, it is magnetized with varying intensity, depending on the amount of current produced by the sound of the heart or lungs. When the motion of the wire is reversed, the same apparatus produces the sounds in a telephone receiver.

Portable Steel Mast Is Hitching Post for Airships

Y-SHAPED airship mooring masts that will securely anchor dirigibles of any size in the strongest gales have been successfully tested at Langley Field, Va. The masts are 72 feet high, in four 18-foot latticed steelwork sections that can be transported readily in motor trucks.

Instead of holding a dirigible by its nose cap only, as in the case of masts previously designed, the new anchor grasps the airship between steel arms forming the upper section of the Y. This section turns freely on the mast, and keeps the airship pointing into the wind. Meanwhile the two-point suspension holds the hull steady in sudden gusts, which twist and strain the structure of a dirigible that is moored by the nose alone.



In mooring, the airship drops its rope, which is fastened to a cable from the tower. A winch then draws the dirigible between the tower arms

Mast Holds Any Size Ship

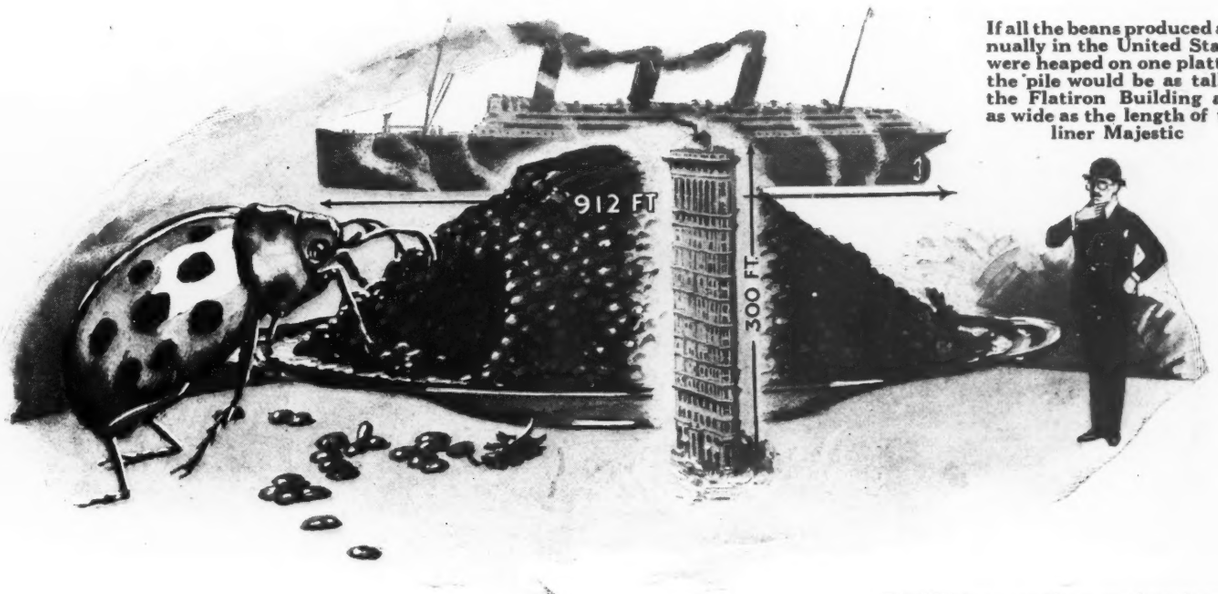
The steel arms end in cone-shaped, padded buffers that fit in sockets at the sides of the airship. Since these sockets may be located at almost any point of the airship's structure, the tower will moor ships of all sizes, from the *Roma*, with its 1,200,000 cubic foot capacity, to the smallest blimp.

In making a mooring, the airship hovers over the field at an elevation of about 100 feet, then drops its mooring rope, which is fastened to a cable leading from the tower. This cable passes down from the swivel at the base of the arms to a hand-operated winch. Winding the winch then draws the dirigible between the arms of the tower. Towers at permanent stations will eventually be equipped with pipes to carry helium, hydrogen fuel, air, and water, refueling in a few moments.

Brought to rest between steel arms, the ship is held securely by padded buffers. The arms pivot freely, keeping the ship pointing into the wind

New Beetle Menaces Great American Food Supply

"Ladybug" Marauders from Mexico Discovered Sweeping over United States and Devouring Our $100,000,000 Bean Crop



If all the beans produced annually in the United States were heaped on one platter, the pile would be as tall as the Flatiron Building and as wide as the length of the liner Majestic

By C. A. Briggs

HOW long can the great American plate of beans survive the Mexican bandit beetle's appetite? Even now, this newly discovered marauder is consuming more beans than Boston, and is rapidly destroying one of our most health-giving foods. The annual value of America's bean crop, represented in this platterful, is $100,000,000. Seventeen million bushels are contributed chiefly by New York, Michigan, Colorado, New Mexico, Arizona, and California. One bushel weighs about 60 pounds and each pound represents fuel value of about 1600 calories, as compared with about 1100 calories from a pound of fresh beef, 165 to 310 from milk, and 1200 from white bread.

BAKED beans at a dollar a portion! Is the plebeian bean to be driven from its present democratic company into the ranks of the aristocracy?

This possibility is suggested by the recent invasion of the southern portion of the United States by the Mexican bean beetle, a bandit pest of the first magnitude that now has gained a firm foothold and is already at work in a limited territory, undermining natural resources with such telling effect that the final outcome is a matter of grave concern.

Northern Districts Threatened

Beans of all kinds are being attacked by this bandit—a kind of ladybug—and entire crops are being wiped out.

Indications are that the Southern bean crop will not be the only one to suffer, but that in course of time the beetle will invade the northern districts as well. As far as climate is concerned, it can probably thrive in any part of the United States, for it hibernates through the winter, sometimes in colonies, and will survive temperatures of -30° to -40°F.

The invaders appear, after wandering in the desert, to be entering upon fertile valleys all prepared for their greater comfort and expansion. In 1919, a Southern farmer planted an acre of beans. From the crop he received $400, and in addition his wife put up a quantity for their own use. In 1920, the acreage was doubled; the beetle arrived in July, and the total yield was not sufficient for his wife to can! In its amazing gluttony, it leaves nothing for its servant, man. Attacking stalk, leaves, and pod, it quickly reduces the whole plant to shredded fragments, dying in the sun.

The marauder attacks snap beans, string beans, lima beans, soy beans, alfalfa, and other related plants. In addition, the adult form will feed on a large number of plants representing widely separated botanical families.

One of the most serious features of the situation, however, lies in the fact that the bean beetle attacks the very plants that possess the double agricultural value of not only supplying food and fodder, but likewise of fertilizing the soil.

The bean family is notable for the formation of certain tubers on the roots. These tubers, in conjunction with the action of bacteria, take nitrogen from the air and combine it to form nitrates that enrich the soil. Upon this fact are based some of the most far-reaching advances of modern agriculture of immense importance to the South. Ultimately, if no remedy is found, the result will be that the nitrogen which the beans were expected to supply to increase soil fertility must be obtained from other sources. In all cases, this means power, and power means coal. Whether produced with the aid of electrical energy supplied from large generators or by depleting the world's mineral supply by hauling nitrates from distant Chile in ships, coal that otherwise would remain for future needs is used up.

Menace to Coal Resources

Indeed, it is difficult to imagine a pest with a more complete combination of destructive vices. It attacks the few nitrogen-producing forms of vegetation; and nitrogen is needed for proteins—the particular food that gives potency to the energy furnished by the carbohydrates or elements based on carbon. It threatens to use up indirectly the coal needed for heating our homes and driving our machinery.

The ladybug or ladybird beetle, of nursery rhyme fame, with its

Man *versus* the Insects

"THE next war will be Man *versus* the Insects!" says Sir Harry Johnston, famous English scientist and explorer.

"The insect has become to-day the most powerful rival of man," says L. O. Howard, Chief of the United States Bureau of Entomology.

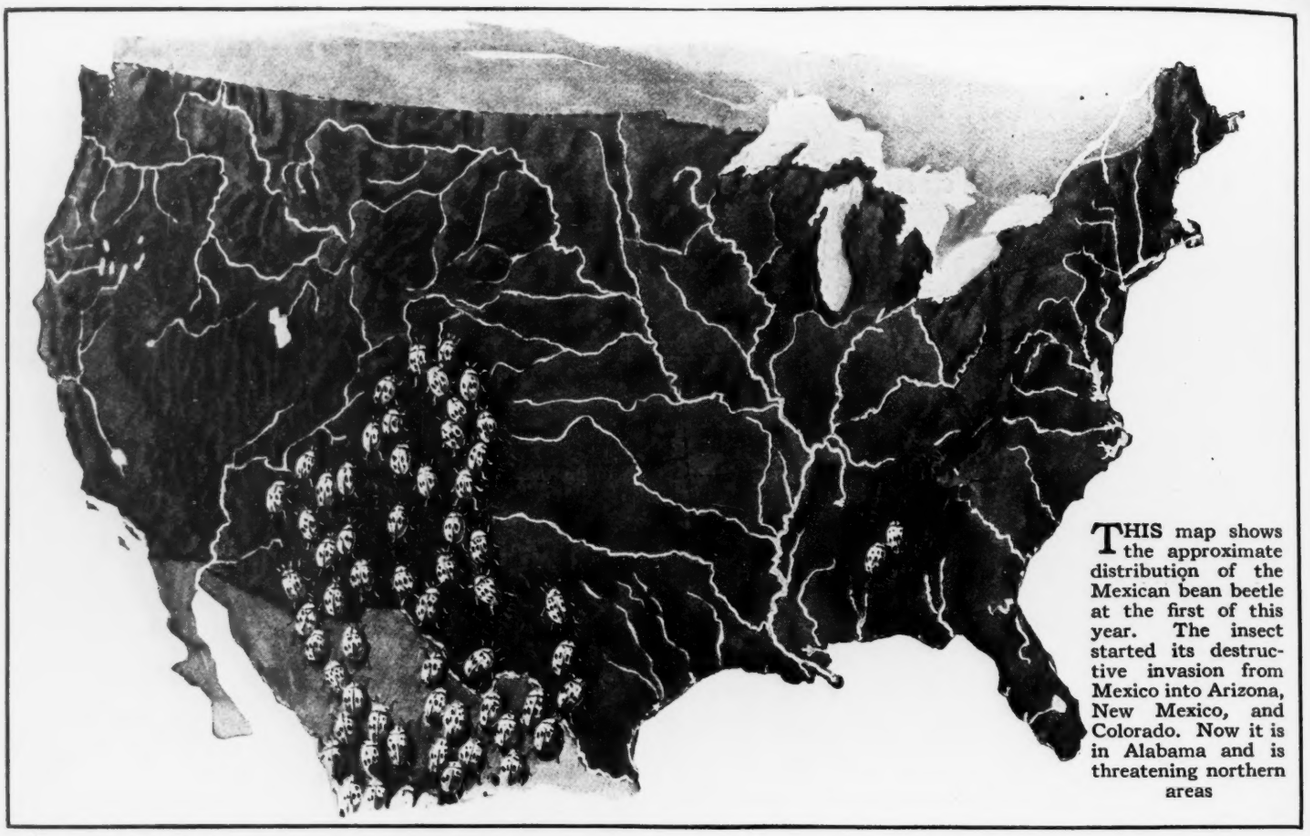
"If the insects stopped fighting among themselves, they would wipe us off the earth," declares another famous scientist.

Insects destroy many millions of dollars' worth of crops annually; they make us pay higher prices for the clothes we wear, the food we eat, the homes we live in. They cause famine and pestilence. We have just begun to learn how many diseases, resulting in tremendous loss of life, they carry.

Man, calling himself the master of nature, may yet be involved in a life-and-death struggle with insects for possession of the globe—and in some ways, scientists declare insects are better fitted than men for survival on earth.

This article concerning the latest insect tribe to assail American agriculture, is especially significant when read with the foregoing points in mind.

—THE EDITOR.



THIS map shows the approximate distribution of the Mexican bean beetle at the first of this year. The insect started its destructive invasion from Mexico into Arizona, New Mexico, and Colorado. Now it is in Alabama and is threatening northern areas

little domelike body covered with shiny polka-dot wings, has always been credited with belonging to the best of bug families. Beetles of this large family have busied themselves for the most part with eating up the larvæ of bad bugs that were harmful to the crops of man.

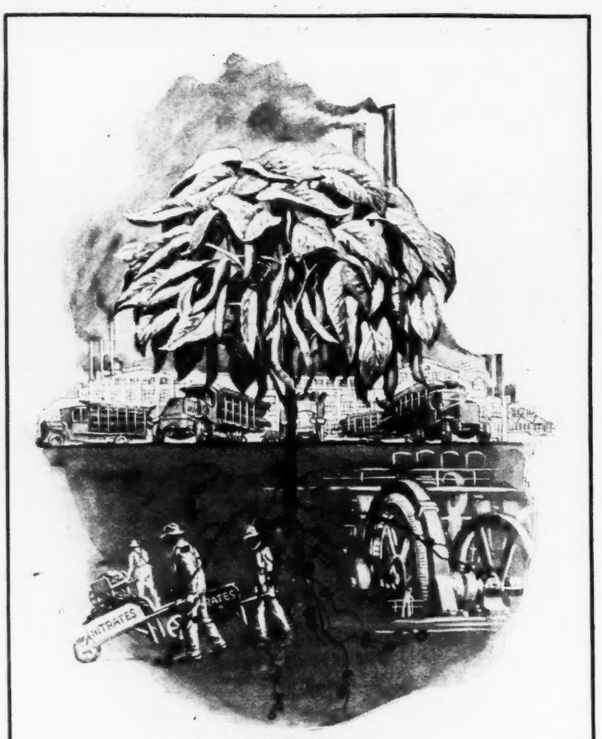
But about 40 years ago, the destructive bean beetles began an invasion into Arizona, New Mexico, and Colorado, where they have done large but sporadic damage to crops of beans, probably preventing the development of an important industry. The damage to last year's crop in the Estancia Valley alone was $100,000. While the damage in the West was marked, the pest's menacing character did not develop until its recent appearance in the South.

Bug Likes All Climates

It probably was introduced there in alfalfa shipped from the West to Southern army and mining camps during the war. Its first appearance was in the vicinity of Birmingham, Ala., in 1918; and it was reported to the United States Department of Agriculture in 1920. Neither changes of humidity nor temperature appear to disturb it, and it has already shown that it can thrive in localities where the rainfall varies from 10 to 65 inches annually.

The adult insect is about one quarter of an inch long. Each of the two wing cases are marked with eight roundish black spots on a background varying from lemon yellow to a deep orange color. The orange-yellow eggs are laid on the lower surfaces of leaves in groups numbering from 40 to 60. A total of 2000 eggs has been laid by a single female. Probably 1500 would be the average figure.

In midsummer weather the eggs hatch in six days' time into yellow larvæ about one twentieth of an inch long, covered with jagged branchlike spines. Feeding upon the lower surfaces of the leaves and preserving the upper portions as a sort of sunshade, they grow rapidly, and after molting four times, they develop into large grubs about one third of an inch long. The pupas next formed are somewhat smaller, about the size of an adult beetle. In favorable weather the adult form will develop from the egg in from 22 to 30 days, and will in turn lay eggs 10 days after maturity.



EVERY beanstalk is a natural Muscle Shoals plant. Attached to its rootlets are small growths that, in combination with bacteria, draw nitrogen from the air and transform it into nitrates. Thus, while bean plants are supplying the United States with $100,000,000 worth of food annually, they are rendering an additional, invaluable service by replacing some of the 3,000,000 tons of this fertilizer removed from the soil each year

Plants Entirely Destroyed

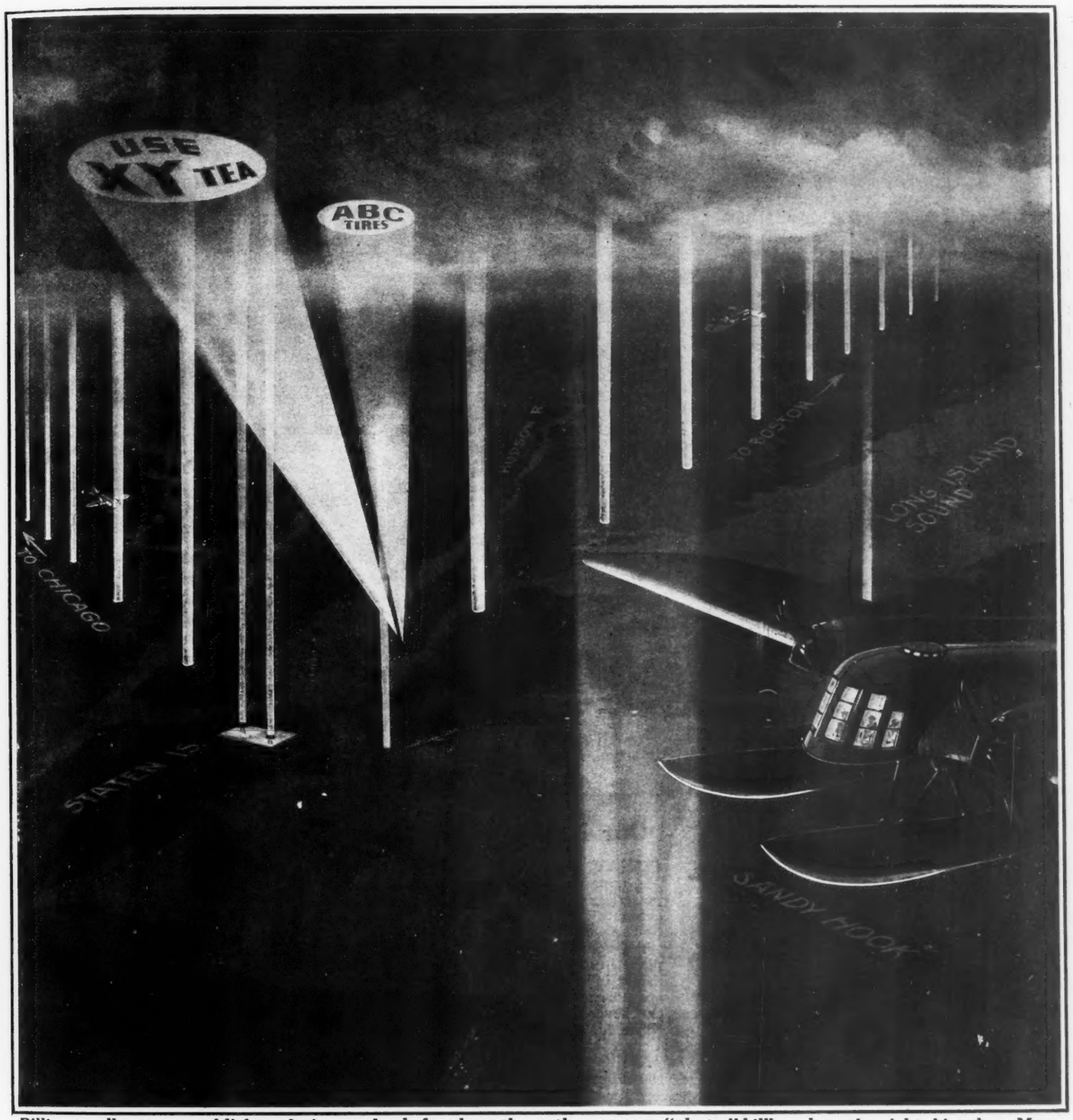
The mature bug also feeds on the lower surface of the leaves. When the leaves are gone, they attack the pods.

It is strikingly evident that the bugs multiply very rapidly; and, after making an insidious start in the new region, in a couple of years they appear in devastating numbers. Marked beetles have been known to fly five miles in two days.

Satisfactory methods of controlling the pest have yet to be found. Several animal parasites of the pest are known, but none of these offer to exert any effective combat. That a successful adversary may exist in Mexico is possible, and this possibility is being studied.

Hope of eliminating the marauders has long since vanished. If beans are to remain a household article of food, some means of combating the invading army will be necessary. The present annual value of the bean crop in the United States is $100,000,000. From this huge yearly food pile, the Mexican bandit beetle is already consuming more beans than Boston!

Monster Searchlight Forecasts Dazzling Night Skies



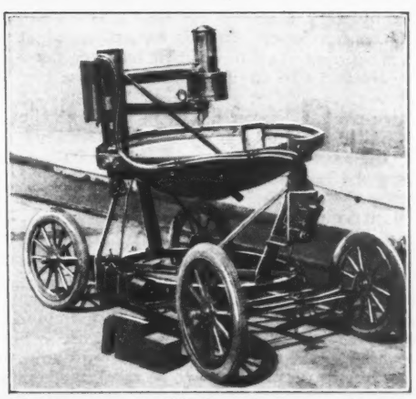
Billion candlepower searchlights, playing on clouds far above the earth, may soon "plaster" billboards on the night skies above Manhattan and illuminate airplane thoroughfares leading from New York to Chicago, Boston, and southward along the Atlantic coast

SHIPS at sea off New York, a short time ago, began an exchange of radio comment on a glaring light pointing into the clouds.

Some observers guessed it was the aurora borealis; others thought it was lightning. It was neither. It was the beam from the most powerful searchlight in the world—the 1,400,000,000 candlepower torch perfected by Elmer Sperry, noted inventor, and installed in a lighthouse in New York harbor.

This light, tested for possible use as a beacon for airplanes, throws its beam vertically in the air. It will penetrate thick banks of moisture, and is visible above the clouds. It has lighted up clouds 10 miles above the earth.

As the result of its spectacular effects, advertising concerns already are considering the possibility of blocking out part of the light to type words and draw pictures on the sky.



The Sperry searchlight. Its encased arc is held over the five-foot reflector by steel arms

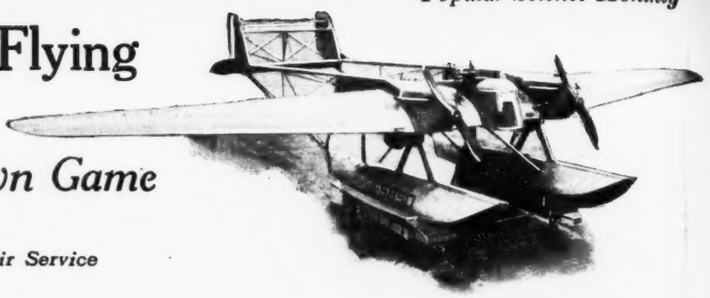
The Sperry light is operated on the comparatively small current of 150 amperes and 110 volts. The intensity of illumination is due to an improved type of carbon used in the arc, which has a core of refractory mineral salts. A long arc is used, and this produces a small ball of incandescent gases in the heart of the carbon electrode.

As the source of light is a point, a parabolic mirror five feet in diameter reflects all the light produced. The light is mounted on a special chassis so that it may be moved about when used as a landing light on airdromes.

What's the Matter with Flying in America?

Europe Outstrips Us at Our Own Game

By William Mitchell
Brigadier General, U. S. Army, Assistant Chief of Air Service



Slung between twin pontoons, a Whitehead torpedo is carried by the new Curtiss naval seaplane

WE Americans invented the airplane. We taught the world to fly. With a marvelous spurt, we built nearly 16,000 airplanes and nearly 50,000 airplane engines in 18 war months. We established the world's first and finest regular postal air service.

And to-day we have nearly killed this epochal industry that our own inventive genius created! Only about 150 planes were built last year. No commercial airplane line on regular passenger schedule was operated. Meanwhile, Europe was being crisscrossed by scores of air liners,

The new seaplane during its recent test flight before naval officials at Hampton Roads

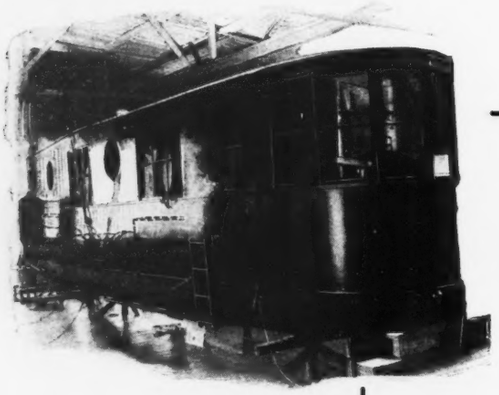
Other Nations Are Active

We have allowed every other principal country to outstrip us in airplane design, in airplane construction, and in the commercial use of planes. Every principal country is likewise outstripping us in aeronautical appropriations and in the encouragement of flying—military, naval, commercial.

What is the matter with flying in America?

Isn't it up to the public to answer?

For the only thing the matter with aviation in this country is that there's so



Dotted lines indicate the position of the unit power plant, pictured at the right, in the enclosed gondola of America's newest "blimp"

mighty little of it! And may not the lack of public support for the airplane industry largely account for that?

Certainly the reason the world has beaten us in aviation isn't that airplanes are not available, for we have a score of bona fide, experienced manufacturers on a producing basis just aching to sell machines.

It isn't that aircraft are not popular, for somewhere in the country there are 14,550 army and navy pilots and observers, and hundreds of thousands of admiring civilians who want to fly.

It isn't that aircraft are uneconomic, for more than sufficient proof has been given of a hundred everyday uses to which they can be immediately put, with savings in time, money, and energy.

It isn't because of prohibitive or annoying legislation, for there is none that is worth speaking of.

And surely it isn't because these craft are impractical, for the daily operation of passenger routes all over the world—save in America—proves beyond cavil their reliability. And America can add the proof of its own incomparable air mail service.

Four companies have been operating continuously between Paris and London—two French and two British. These make the cross-Channel journey in three hours or less, with the fare one way somewhere about $31.50.

The London-Brussels trip is made in 2 hours and 45 minutes; the London-Rotterdam-Amsterdam trip in about 4 hours; the Paris-Brussels-Amsterdam, in 4 hours and 25 minutes; the Paris-Strassburg-Prague-Warsaw in 12 hours and 30 minutes; Toulouse-Barcelona-Alicante-Malaga-Rabat-Casablanca, four times a week, in less than 32 hours—and so on.

During 1920, 10 French major commercial air companies maintained regular air traffic over important continental routes, in a radius touching points as far apart as Prague and Casablanca. A great air port has been created at Marseilles, the gateway to French influence in Africa; and another at Constantinople, the door to the Orient.

Network of Airplane Routes

In 1920, these firms made 2370 trips, covering, roughly, about 293,610 miles. They carried 108,568 pounds of freight and 6510 pounds of mail. In August alone of 1921 the French lines carried 2473 passengers and over 37,000 pounds of freight. The Compagnie Franco-Roumaine has a Paris office twice as large as the French transatlantic steamship line.

Germany has a network of airplane routes and, until of late, airship routes as well. Two of the large concerns operating airplanes over these routes, carrying passengers and mail, have connections with great shipping concerns that have turned to aeronautics for their endeavors, coincident with the loss of shipping. These routes, too, operate

Our Inventors Are Awake

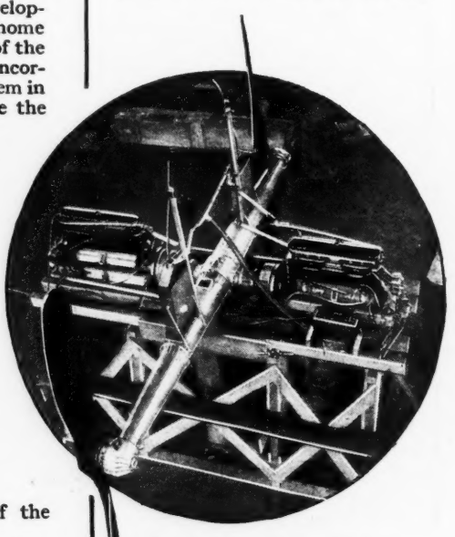
THAT apathetic public opinion and an apparently indifferent government are powerless to stifle the enterprise of American aeronautical engineers is proved abundantly by the photographs on this page.

Above is pictured the new Curtiss torpedo plane, in whch is embodied the latest developments in aeronautical thought both at home and abroad. The monoplane wings are of the cantilever type with engine nacelles incorporated. The pilot is placed between them in a control nacelle, and immediately above the torpedo, which is slung between the two pontoons. A speed of 100 miles an hour, developed by the two 400-horsepower engines, can be maintained for three hours and a half.

Of the military airship now being built by the Goodyear Tire and Rubber Company for the United States army the most interesting feature is the completely enclosed car which is carried beneath the envelope. In this car, pictured at the left, are mounted all navigating and engineering controls and the engines that drive the two propellers.

This two-engined power plant, pictured at the right, is hailed as a notable engineering achievement for the reason that engines, clutches, coupling gears, shafts, and housings are all assembled in one unit. As a result, it is possible to mount the power plant squarely in the interior of the car, under the eye of the crew. If necessary, they can even tear down and reassemble one or more of the cylinders during flight.

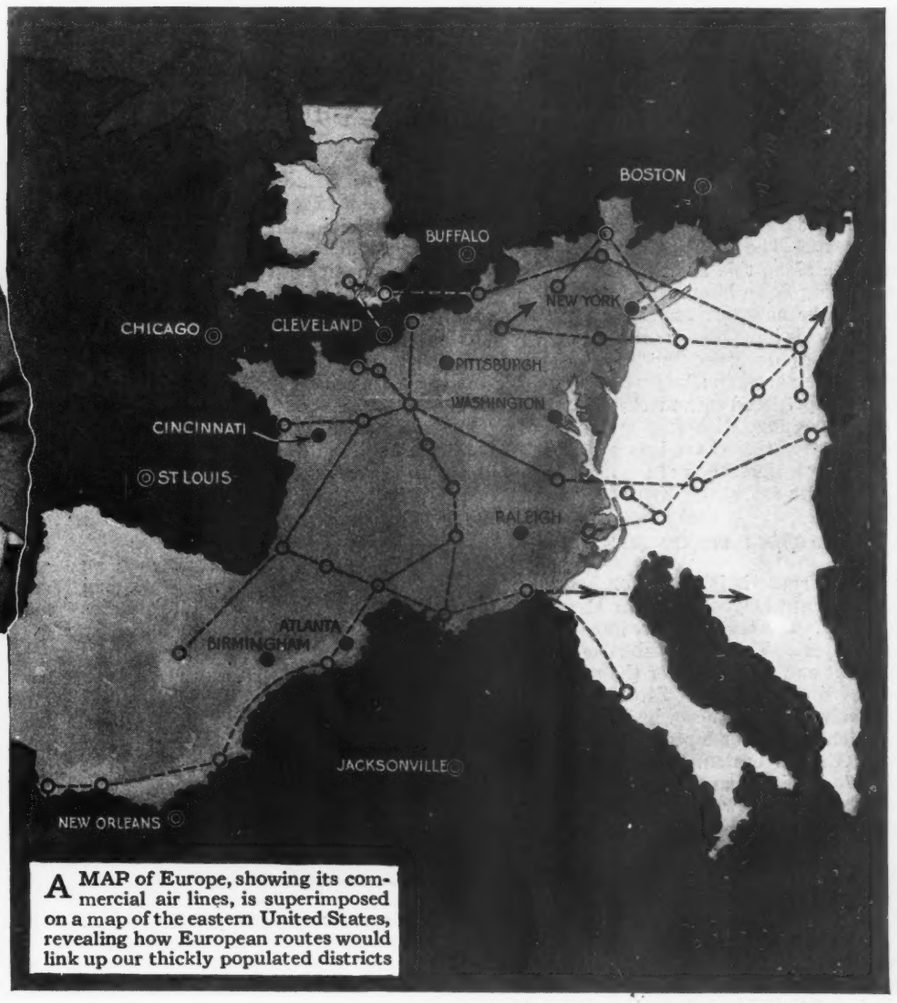
Water ballast is carried in the floor of the car, and on the navigator's instrument board there is a dial indicating the amount of water available for ballast. The fuel tanks, located in the rear of the navigating cabin, are so constructed as to permit them to be used as sleeping cots on long flights. Provisions are made for a crew of seven.



In this power plant for America's newest airship, the engines, clutches, propeller shafts, and gearing are all assembled in one unit to simplify installation and control

How Europe's Air Lines Would Serve Eastern United States

Brigadier-General William Mitchell, Assistant Chief, United States Army Air Service



A MAP of Europe, showing its commercial air lines, is superimposed on a map of the eastern United States, revealing how European routes would link up our thickly populated districts

successfully and usually on time.

In the 166,600 miles flown by one make of airplane over various German routes in 1921, 693 trips—or 95 per cent of those scheduled—were successfully completed. The routes flown over varied from 180 to 270 miles in length.

America Far Behind

But in America not a single passenger air line has been in regular commercial operation between any two cities, despite all these proofs of efficiency that foreign countries provide.

This means that our manufacturers are hard hit. Airplane making members of the Aircraft Manufacturers' Association, representing nearly the entire bona fide operating industry, built but 76 airplanes in 1920, and 142 in 1921, to October 1. The army and navy took 21 of these in 1920, and 142 in 1921, and the Post Office two in 1920.

Compare these figures with the production of American aircraft factories during the 18 months of war. In that brief effort our factories turned out 16,000 planes.

Yet, gloomy as it may seem, the picture is not without its cheering aspects. In the situation today are the seeds of growth and promise.

Public Interested in Flying

The American public has always been interested in aeronautics, first of all, from the point of view of the looker-on. It has always taken advantage of every opportunity to fly. And there is a vast number of persons interested in aeronautics very especially. The war brought into active touch with every phase of military and naval aeronautics 219,977 men from every state in the Union and from her possessions. There were in the Army Air Service a total of 20,708 commissioned officers and 174,469 enlisted men. In naval aeronautics there were 2800 officers and 22,000 enlisted men.

Of these, a big percentage are actual flyers—ready for the coming of aerial travel. The army graduated from elementary flying training 12,000 officers, pilots, and observers, and the navy 2100 pilots alone. A goodly share of the airplane pilots can be called expert flyers, the kind that will be needed for the pilots of air routes.

Future Big with Possibilities

Here is a potential market for privately owned airplanes—were the cost within the range of the pocketbook. Here is a big group of intimately interested people who may be counted on to jump into the game as soon as there seems some feasible outlook for their endeavors. They are watching developments. Of these trained men many are already in aeronautics, so far as they can be. The army has something like 8400 pilots, observers, and non-flyers, and the navy 1660 officers in the reserves.

Similarly all over the country there is a constant undercurrent of activity awaiting the floodtime. Here and there individuals and little companies are endeavoring to start small businesses—giving exhibitions, teaching flying, doing passenger carrying, making aerial photographs and maps, and planning express and passenger service. There are over 150 companies who consider themselves manufacturers; and there are over 100 claiming to be in the exhibition-flying-passenger class.

Just as in personnel, so in engineering facilities, America has the possibilities of a vast development. The Army Air Service has its own engineering and experimental laboratory and plant; the navy likewise. The Bureau of Standards has a number of laboratories working in aeronautics. The Bureau of Mines is concerned with the investigation of fuels, helium, alloys, etc. The Forest Products Laboratory has to do with aircraft woods. The National Advisory Committee for Aeronautics determines miscellaneous experimental problems to be attacked, has its own laboratory, and is supposed to coordinate all government agencies. The National Research Council cooperates in instruments, signaling, photography, and the like. The Engineer Corps of the army, the Air Service, the Board of Surveys and Maps, the Coast and Geodetic Survey, and the United States Geological Survey have all been concerned in aerial mapping; and there are still other agencies that certainly will later be concerned with the aerial photograph.

What the Government Is Doing

The Post Office operates the airplane mail, and experiments on and reconstructs airplanes and radio. The Weather Bureau, Signal Corps, and the navy are all concerned with radio broadcasting of weather information, which is indispensable to aerial traffic. The Forest Service and the Army Air Service cooperate in airplane protection for national forests, and the Bureau of Entomology and Bureau of Fisheries have

THE only thing the matter with aviation in this country is that there's so mighty little of it. And may not the lack of public support largely account for that?"—*Brig. Gen. William Mitchell.*

utilized Army Air Service in their work. The United States Coast Guard has already established an air station on the coast, with planes obtained from the navy.

There are the beginnings of a great aeronautical development, too, in the landing fields that are being established throughout the country. The Army Air Service has done much along this line in the past two years, having flown hundreds of thousands of miles over new territory. Nearly two thousand fields have been located and their characteristics recorded and published. Many of these are municipally or privately owned, and prepared with markers, landing tee sand, housing, with fuel and oil and spares. Lists of these have been published. There is now a Blue Book of the air, giving all known data concerning these fields.

Towns Mapped on Sample Route

A sample route is in operation between Washington and Dayton, Ohio, *via* Moundsville, W. Va. It is traveled over incessantly by army flyers. This was established as an experiment and as a guide for the mapping of routes by civil firms. Along this line towns are marked in accordance with the international system adopted by the International Air Convention.

The Weather Bureau also is active aeronautically. It is now in a position to furnish information in advance of flight as to fog, smoke, winds, visibility, and the like, having 132 stations scattered all over the United States, from which information may be had by any pilot upon application. To the army and to the navy, incidentally, there is valuable meteorological information from other stations. The navy has a number, and the Signal Corps is expanding its meteorological project from the present 20 stations to as many military posts as have units of the Air Service.

On the experimental airway between Washington and Dayton, and Washington and New York, well developed systems of information and supply already exist.

But most promising, perhaps, of all indications that America is prepared for a vast aeronautical development, is the fact that the American public is awakening to the safety and entire practicability of the airplane.

No example of this demonstrated practicability is better known to the American public than our own air mail. Last winter, and the winter before that, when storms came and the wind blew and the rain and hail and fog made terrestrial travel an abomination, mail pilots were flying above, below, around, and through the clouds and storms in the actual delivery of mail. They flew when the "tin Lizzie" stayed in the barn. They completed 88.82 per cent of all aftempted flights.

From the inception of the air mail on May 15, 1918, to October 1, 1921, mail planes have flown 26,215 airplane hours over routes. Many more hours have really been flown in tests, deliveries, etc. So far as records show—and one cannot go back of these—the distance flown is 3,881,648 airplane miles, the equivalent of more than 123 times around the world. The ratio of fatalities to airplane hours flown is but one death to every 133,984 miles.

On three of the routes of the Rumpler Air Line in Germany, the percentage of reliability ran from 81 to 96.6 per cent, ten trips being defaulted on account of bad weather.

These figures represent possibilities at their worst. Civil flying for sport and for general commercial uses, save transportation, perhaps, will be done only in fairly decent weather, the same as houses are built, automobile tours made, baseball played, and so on.

The public is learning that the airplane is practicable. It is learning, too, that it is safe. In three years of passenger flying in the United States, "Eddie" Stinson has carried 8000 people without an accident. In covering 744,000 miles in 1919 and 1920, the regular and permanent French air lines, according to the veteran pioneer, Henri Farman, has had but seven fatalities—or one for every 106,000 miles. The operators of Fokker airplanes over routes connecting London, Amsterdam, Rotterdam, Bremen, Hamburg, Danzig, Königsberg, Memel, Riga, between April 1 and September 1, flew 166,000 miles without accident.

Dangers Are Exaggerated

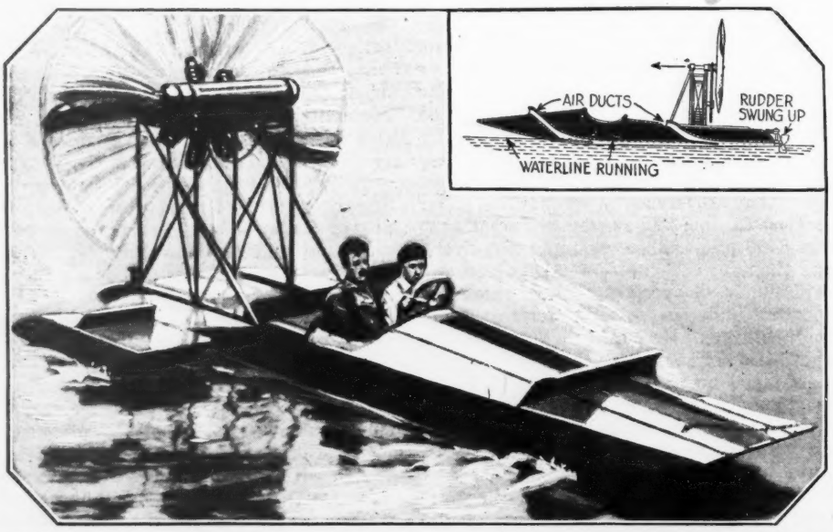
"The dangers of airplane transportation . . . may be largely exaggerated," says an insurance company in its book, "Airplanes and Safety." There are now many insurance companies writing aircraft insurance as a part of their regular business. Aerial insurance is written as compensation for flyers or ground employees, for the machines themselves, and passenger hazard, against suits arising from injury to the public, individual accident insurance, and the like. Is it not interesting to see an insurance company publishing an optimistic work on safety in flying?

There are reasons for encouragement, also, in the cost figures. In a recent competition, trips were made between New London, Conn., and New York, and between Port Washington, Long Island, and New York, carrying passengers at a cost of 14.7 cents a mile.

So it is that the proved economy and reliability of aircraft point to the inevitable coming, sooner or later, of regular passenger air service in America. But its coming will be delayed unless sane, comprehensive aeronautical legislation receives strong public support.

New Hydroplane Boat Skims Waves on Cushion of Air

ONLY nine square feet of the bottom of a new hydroplane skimmer, driven by an airplane propeller, is in contact with the water when the craft is developing its full speed of 60 miles an hour. An ingenious system of air cushioning makes this possible. Since the two supporting surfaces are set at an angle of only 2½ degrees, the speed per horsepower is said to be the greatest ever attained.



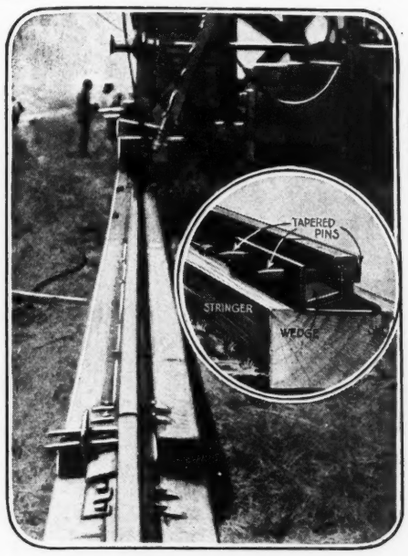
Driven by an air propeller, the skimmer, riding on air cushions, develops record speed to the horsepower. The ingenious system of cushioning is made clear in the inserted diagram

Two wide funnels, facing toward the bow, collect the air and are connected with flues which have their outlets under the hull. One flue is located about a third of the way from the bow, the other a third the distance forward from the stern. At each flue outlet there is a large cavity in the bottom of the boat.

At high speeds the air pressure against the funnels, aided by the suction created by the water passing the mouths of the flues, forces a large volume of air under the hull, so that the boat rides largely on a cushion of air and spray. At high speeds the outrigger leaves the surface altogether. Escape of the air is prevented by runners or fins on each side extending three inches below the bottom of the hull.

VERY dense charcoal with high absorptive power, needed for gas masks and previously obtained by carbonizing peach pits and cocoanut shells, can now be manufactured from soft-wood sawdust, required density being supplied by pressure.

Blows of Sledge Assemble Rail Joints Quickly



QUICK-ASSEMBLY rail joints that may be assembled or disconnected by a few blows of a sledge were invented recently by a construction gang that wished to make a record for rapid laying of concrete pipe.

The joint has only four parts—a curved clamp, shaped like a shoe, under the ends of the two abutting rails; a flat, tapered steel wedge four inches wide that jams between the rails and the upturned end of the clamp, and two tapered steel pins that are driven through the bolt-holes in the end of the rails and wedge into holes drilled in the upturned edges of the clamp.

The pins prevent the ends of the rail from rising or settling, and the wedge driven between the rail and the sides of the clamp guards against spreading.

Rubber as a Lubricant

RUBBER is now being used as a lubricant for valves on superheated steam-lines where the steam would destroy grease or oil and cause the valves to leak.

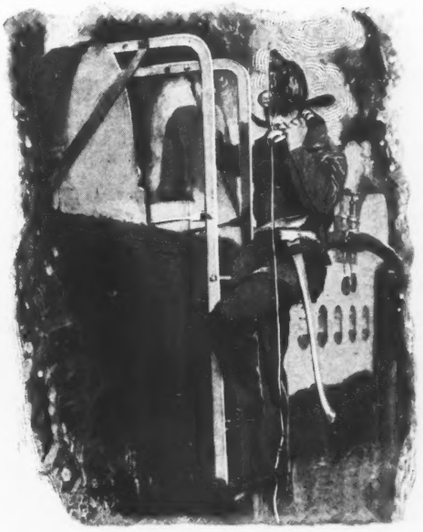
Four parts of rubber mixed with one of tallow are heated until the whole becomes liquefied and then solidifies into a jelly.

Tallow appears to have a solvent action on the rubber, and the mixture stands up well under severe conditions.

Portable Telephone Saves Fire Fighters

FIREMEN far up on the roof of a burning building, or out of sight in the choking smoke of a subcellar fire, can now keep in touch with the fire chief through a system of portable telephones recently tested by Fire Chief Thomas R. Murphy, of San Francisco, Calif. Firemen with whom the chief wishes to maintain communication are equipped with light receiver sets that can be plugged into sockets on a wire.

How the chief communicates with a fireman high up on a burning building



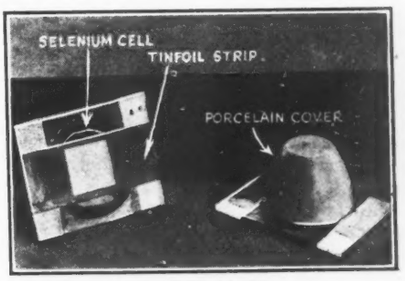
By keeping the chief informed of conditions as they arise, and enabling him to warn firemen of dangers, such as the possible collapse of a roof, the portable telephone is expected to promote more efficient fire fighting and to greatly reduce the risk to life.

The outfit is light and compact, and the entire equipment can be packed into a box about the size of an ordinary suitcase.

Cuff Buttons Stretch as You Roll Your Sleeves

CUFF buttons that stretch apart so that the wearer can pull his sleeves up to the elbow without removing the buttons, simplify washing the hands and keeping the cuffs clean.

The buttons are on the ends of a U-shaped clip of spring wire about three inches long. The spring holds the edges of the cuffs closely together.



Selenium Cell Serves as Radio Detector

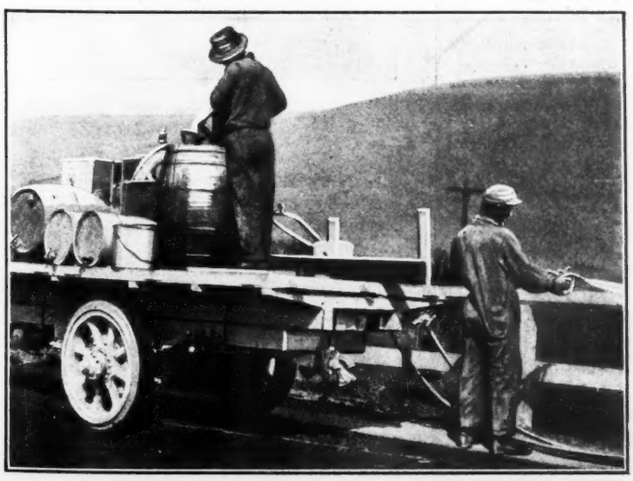
THROUGH the invention of an improved selenium cell, smaller and more sensitive than anything available heretofore, experimenters can now develop selenium's rare property of producing an electric current directly proportional to the amount of light falling upon it. The delicacy of the cell, perfected by Russell Hart, of Los Angeles, is demonstrated by its ability to serve as a wireless detector.

The cell consists of a thin sheet of platinum fused on glass, over which crystallized selenium is applied in a very thin layer. The width of the electrodes is carefully graduated by cutting away the platinum tip with an engraving tool. Over the whole cell is mounted a porcelain cup filled with desiccated calcium chloride as a protection to keep the cell bone dry.

For high-speed work, where the electrical response to fluctuations in the intensity of the light must be as rapid as possible, the cell is made with the thinnest possible film of selenium, and the platinum electrodes are engraved to within 1/3000 of an inch of their calculated size.

The full sunlight resistance of such a cell will be from 10,000 to 20,000 ohms, and its resistance in darkness from 1,000,000 to 2,000,000 ohms.

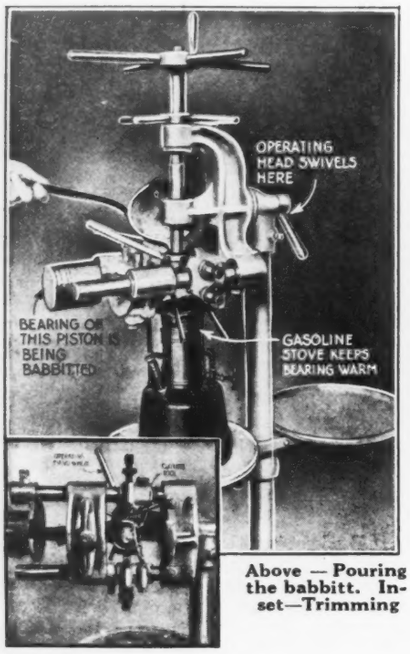
Spraying Machine Paints Highway Fences



PAINTING highway fences with a portable spraying machine mounted on a truck is saving time and money in California.

Two men operate the outfit, one to keep the paint reservoir full and to operate the gasoline-driven air compressor, the other to direct a mist of white paint against the fence. From 1000 to 1500 feet can be covered in a day.

Babbitting Jig Casts, Cuts, and Trims Bearings

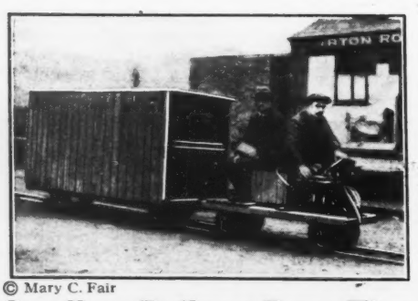


Above — Pouring the babbitt. Inset—Trimming

A UNIVERSAL babbitting jig that will cast, cut, and trim babbitt bearings of most sizes in less than 20 minutes is a new invention designed to enable auto-repair shops to produce bearings quickly and inexpensively.

The mandrel, which keeps the core of the bearing the proper size, is fastened in place, and the hot metal poured. A convenient shelf for the blowtorch, placed below the fixtures, warms the bearing while the babbitt is poured.

After the babbitt is cool, the top of the machine swings on a pivot into a horizontal position. Adjustable cutting tools are inserted in a chuck on the bottom of the mandrel bar, and by turning the hand wheel a mechanic can rapidly cut and trim the babbitt. No change of adjustment is required in making a change from the casting to the cutting position.



© Mary C. Fair

Smallest Railway Runs Tiny One-Car Train

THE 15-inch gage line that runs up the beautiful valley of Eskdale in West Cumberland, England, is probably the world's smallest railway. Only one car, accommodating 12 passengers and drawn by a four-horsepower gasoline motor, runs on the line.

In spite of its size, this railroad carries freight, passengers, and mails, runs on a regular schedule, has its own stations, tickets, and—it is reported—its own labor troubles. The terminus of the line is at the foot of Sea Fell, England's highest mountain.

What Do You Want to Know?

Why a Blotter Blots

What is it that makes blotting-paper blot?—S. R.

The fibers of blotting-paper are packed loosely, forming numberless small pores. When the paper is laid over wet ink, the liquid is drawn up into these pores just as water is drawn up into capillary tubes.

When Bullet Stands Still

If a bullet with an initial velocity of 60 miles an hour is fired from the rear platform of a train moving with the same speed in the opposite direction, where will the bullet land?—W. R. P.

The bullet will land at a point directly under the location of the gun at the time it was fired.

The Weight of Cork

Will you tell me the weight of a sphere of cork that is 10 feet in diameter?—E. F. G.

The average weight of cork is 15 pounds a cubic foot. Since the contents of a sphere 10 feet in diameter is equal to 523.6 cubic feet, the weight of the cork would be 7854 pounds.

Why Soap Bubble Is Round

Why is it that a soap bubble is always round?—P. S. B.

The surface tension of the thin membrane causes it to contract to the smallest area for a given volume, which is the surface of a sphere.

Dry Steam and Iron

Will iron rust in dry steam?—T. K.

If the steam is perfectly dry, the iron will not rust. This has been proved by actual experiment.

"Silver Tone" Is Myth

Is it true that the finest toned bells contain a small amount of silver and gold?—N. Y. T.

No, only in legends. A very small amount of silver will, in fact, detract from the tone. Standard bell metal contains 78 per cent copper and 22 per cent tin.

Liquids that Quench Fire

What are the principal liquids used in fire extinguishers?—P. A. Y.

Aqua ammonia, water charged with carbonic acid gas, solution of ammonium chloride or sodium carbonate and carbon tetrachloride.

The First Paper Money

When was the first paper money issued in the United States?—I. L. M.

On December 10, 1690, the Massachusetts Colony issued £7000, which was so distrusted by the public that it was immediately discounted 20 per cent.

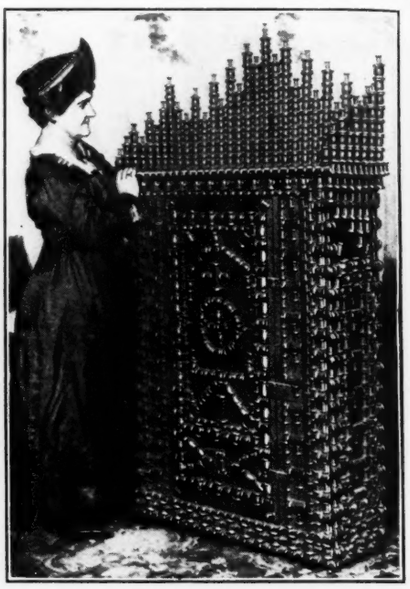
EVERY reasonable specific query in the field of general science addressed to the Information Department will receive a prompt reply.

While lengthy replies cannot be given to complicated questions involving extensive research or computations, this department aims to be of maximum service in supplying information as to what books or other sources may contain answers to these questions. Legal and medical queries cannot be answered.

A stamped addressed envelope must accompany each question, but the writer's name will not be published if he so requests.

Address the Information Editor, Popular Science Monthly, 225 West 39th Street, New York City.

Empty Red Cross Spools Adorn Bookcase



DURING the war Miss Lelia Terrett, of Washington, D. C., used over 800 spools of sewing-thread in her work for the Red Cross. Now she has designed a bookcase decorated with the empty spools.

While some of the thread was used on a sewing-machine, a large part of it was consumed in hand work. Assuming that the average spool held 100 yards of thread, Miss Terrett evidently sewed about 240,000 feet of seams—or about 400 feet for every day the United States was at war.

Sanitary Milkcan Cover Is Operated by Foot Lever

CLEANER and more sanitary milk is obtained by the use of a new hinged cover to protect strainer cloths and milk-cans from dirt and flies. After a sterilized milkcan is equipped with a clean strainer cloth, and is ready to be filled, it is placed in position under the cover, which is made of fine-meshed screen and fits tightly upon the top of the can.

The cover ends in a wooden arm hinged to an upright post near by. A small chain extends from the cover diagonally to the post and thence to a foot lever on the floor near the bottom of the can. The arrangement is such that when the dairyman steps on the pedal, the cover is raised so that milk can be poured into the container.

What Uncle Sam's Wireless Service Means to You

Developments Point to the Time when Government Leaders May Talk to You Daily by Radio on Public Affairs

Watch Washington and Listen!

"WAKE up to wireless!" was POPULAR SCIENCE MONTHLY'S message to the American people last fall.

"Watch Washington!" is our message today.

Amazing as radiophone developments have been since the first article in our radio campaign was published, they are slight compared with new possibi ities.

POPULAR SCIENCE MONTHLY now raises the banner for direct, daily, vocal communication between government leaders in Washington and American homes by radiophone.

We stand for sane encouragement of entertainment broad casts by properly qualified firms, and for a unified national system of scheduled public information broadcasts by the government.—*The Editor.*

How Senator Lodge demonstrated a marvelous new use for wireless by addressing a Massachusetts audience on public affairs via radiophone

By Armstrong Perry

IF the Western Union and the Postal Telegraph and the American Telephone and Telegraph Company should all offer me the free use of their wires, I should consider myself a very privileged man. But if, as a condition, I had to give up the free radio service that my government in Washington offers me, I should turn down the offer with thanks, and without a moment's hesitation!

I appreciate the full value of our great telegraphic wire services—but I actually consider the government's *wireless* system to be of greater value to me at the present time than the free use of all the country's wire lines.

And mark this — within a year I expect to see the government's radio service developed in a way that will make its present offerings look like an 1899 automobile beside the airship *Roma.*

Will You Use It?

This government radio service, even now, is limited only by my readiness—and yours—to use it. It already includes 230 land radio stations. In all probability they will soon be coordinated in one great system through which each one of the government departments can talk to you daily, wherever you are, and tell you the latest facts about the progress of your national business.

Tremendous things, indeed, are even now afoot in Washington. It is one of those moments at the birth of a new era, when people on the inside, seeing amazing things ahead, stand breathless, filled with thrilling projects, yet so staggered by their possible consequences as to hesitate at making the first move; so that, while detailed projects for greater developments are still vague, a reporter on the ground in the national capital can at least safely state that the great radio vision has been seen vividly here in many quarters, and that some of its wonderful blessings are certain to come true.

A survey of government radio developments clearly points the way toward what is coming. In 1914, at a Boy Scout camp, I heard for the first time the 10 P.M. signal from the Naval Observatory at Arlington, and set my watch by it. Thrilling then, the setting of civilian watches is only one of radio's very minor uses now. They are setting international boundaries by wireless today, some old frontier lines having been found to be far from where the surveyors thought they were, owing to the deviation of timepieces carried for long distances over the earth's surface. True, the plotting of these dotted lines seems far from the field of our daily life—until disputes over them throw nations into war!

We Give a Radio Concert for the Blind

FOLLOWING up the campaign launched in these columns last month, *Popular Science Monthly* recently gave a wireless-telephone entertainment to a group of 75 students at the New York Institute for the Education of the Blind. The thrill of listening by radio to the evening's news and music sent out from a big broadcasting station was a memorable event to the blind audience.

The only apparatus required was a detector and two-stage amplifier used with a loud speaker, and a copper wire to the roof.

America has a million hospital patients and tens of thousands of blind, aged and orphan inmates of institutions. Why not do your bit by helping install a radio receiving set in a local institution?

Above—Blind boys examining the radio receiving instruments with their hands. Below—Blind students enjoying radio entertainment. In the foreground is the receiving apparatus

Cure for Blues

But one of the things that government radio is doing for me personally struck me just the other night, when I was far from home and feeling blue. I had set up a little portable radio receiver that I had bought for $25. I was exploring with the tuner to find out what was in the air, and I heard: "Go ahead, Dr. Pierce."

"This is the United States Public Health Service," said Dr. Pierce. "Our talk tonight is on the effect of sunshine." He went on for 15 minutes, telling me how to get the greatest health value from the sunshine and fresh air that destroy the germs of tuberculosis and other diseases. When

What Hays Thinks of Government Radio

By Donald Wilhelm

Will H. Hays

A NATIONAL newspaper without paper! A government radio telephone system that would hook up every home in the land with the leaders of public affairs in Washington!

Shake hands with a big idea sponsored by one who was the livest of all Postmaster-Generals—who was so alert and forward looking that he was drafted from government service into the only industry in the land that holds more spectacular possibilities for universal public recreation and information than radio itself.

Will Hays, our new motion-picture dictator, was one of the first officials in Washington to realize the magnificent future of the radiophone as an agency of the government. Here's what he saw in it:

Public Information Vital

You're a lone woodsman in the wilds, or a farmer's wife, or a miner in the hills, or a pupil in the public schools, or a worker in the shop, or a cattleman, or—well, anyway, you're a human being and in this twentieth century, no matter where you live, public information is your life blood. Your happiness, your domestic contentment, your business, your success in life, your relations with the world, depend upon it. Unless you get it, and get it quickly, you're a caveman or a cliff-dweller. So far as the modern world is concerned, you simply don't exist.

Now, suppose you have on your table a neat little radio receiving instrument. And suppose that every night you could hear from that instrument the voice of some leader of public affairs in Washington, telling you the important events of Uncle Sam's day.

It would be infinitely interesting and entertaining, and invaluable, wouldn't it?

"But is it possible?" I asked Will Hays, while he was still Postmaster-General, and he replied: "Is it possible? Why, it's inevitable! If it cost a hundred times more than it will cost, it would still be inevitable—no cost would be too high for such service. But the cost is not at all prohibitive.

"Since last April, the Post Office Department has been using its chain of transcontinental wireless stations, which it set up to administer the air mail, for broadcasting weather and market information. The Department of Agriculture furnishes us the information."

Supplementing Mr. Hays' remarks, Lieut. James Edgerton, the head of Post Office radio, points out that, at last reckoning, the cost of maintaining and operating Post Office radio is, including interest on investment, salaries, depreciation, repairs, everything, only $87,190 a year. Not a little of this relatively small outlay comes back in the form of economies; thus, reckoning on the basis of capacity use, a radio message of 30 words to San Francisco costs the government $.375, whereas a ground telegraph message, at government rates, costs $1.16.

"The total cost of each new broadcasting station would be $18,875; the annual cost thereafter, $11,170 for twenty-four-hour service," Lieutenant Edgerton says. "There are now sixteen stations in our chain, three of which are navy stations. Add four more, or six—we shall know better when we have equipped the stations we have for broadcasting by phone—and then we'll be able to serve the whole country. There is nothing speculative about it."

In fact, it has been estimated that for the ridiculously low cost of about three quarters of a cent a person a year, the government could reach the whole public with daily broadcasts of news, public speeches, and invaluable departmental information.

There is hardly a government bureau head or official in Washington who hasn't something fascinating to tell each of us, every month or so, if we could only be reached by word of mouth—something bearing, moreover, on our health and prosperity. When the radiophone becomes in fact a great government agency of communication, we shall see the dreams of democratic government more nearly fulfilled, for we shall each of us be kept more closely in touch with public affairs than has ever before been thought possible. When the Post Office uses the wireless phone, it will probably have hundreds of thousands, if not millions, of hearers, receiving, by their own hearthstones, free news, free education, free entertainment—and protection, too, when warning of imminent disaster is sent broadcast to all in danger.

Centralizing Communications

Plans for reorganizing the executive departments in Washington look to making the Post Office Department the rendevous of communications, *i. e.*, civil communications. It might even come to be known as the Department of Communications, or of Post Office and Communications.

All the leased telegraph wires of the government and cable lines as well are to be headed up in that department. The concentration of leased wires, Mr. Hays told me, implies an economy of about $250,000 a year, and better service. Into this scheme the publishing of a national radio newspaper neatly fits.

Every branch of the government needs a broadcasting system to keep in touch with the public. No private agency can fill the need. The problem falls, of its own weight and importance, to the Post Office Department.

Dr. Pierce had finished, the operator played some classical masterpieces on the phonograph, and then a little jazz. The sun was not shining, but the moon was, and I knew where the remarks had hit me. I hiked right out, and in an hour my inward gloom had disappeared.

The next week the Pope was taken ill in Rome, and one afternoon about three o'clock the papers came out with news of his death. That night I copied press from a navy station for an hour. In about a thousand words I received all that was of importance from Dublin, Bogotá, Shamokin, New York, Lisbon, Washington, Indianapolis, Chicago, San Francisco, Mysore, London, Melbourne, and Boston. And I learned that the papers had been several hours premature in announcing the Pope's death. Either the Associated Press, which collects the news, or the navy folks, who send it out, ought to go in for playwriting. They have the dramatic instinct.

This general news, condensed and concise, is invaluable to me and to any man who wants to keep abreast of his time. But what a navy station handed me the same evening, a little earlier, was still more valuable. For weeks, I had read columns, daily, about the Conference for the Limitation of Armaments. With the Conference approaching its close, I found myself muddled about its results. Critics disagreed. Either the United States had accomplished something almost as important as the winning of the war, or it had made a lamentable failure. Which was it?

I put the little receiver on NOF's wave that evening, and heard the operator say: "Hello, Mr. Bacheller. Hello, Oxford Club, Lynn, Massachusetts. We will now run a record or two on the phonograph, and in the meantime we will get in touch with Senator Lodge, and we think he will begin speaking promptly at nine o'clock."

The Senator Speaks—and Listens

I pricked up my ears. I knew Bacheller as a radio man. Senator Lodge I knew also. As our delegation at the Conference had been in closest agreement throughout, his viewpoint would be that of the United States government. I listened.

"Hello, Oxford Club, Lynn."

I recognized the voice. It was a little husky, but firm, as of old.

"Hello, Oxford Club," the Senator repeated.

There was a pause, then the operator of the radio station, which was some distance from Senator Lodge's residence in Washington, where he was speaking, told him over the wire to go ahead.

"But nobody answers!" said the Senator.

In the quietness of my own room, I could laugh at Mr. Lodge's expense. Radio men know that broadcasting stations do not expect or wait for a reply. Their transmission is on schedule, and the receiving operators are in readiness to get their messages. But the Senator, speaking over his phone in the usual way, and knowing little of the intricacies of the station that automatically changed the tones of his voice into radio waves so that they might hurtle through space and be caught and changed back again into sound, was holding his receiver to his ear and wanted somebody to acknowledge his salutation. It was the little bit of fun that makes an official statement a human event.

The Facts First Hand

The navy operator explained and the Senator proceeded. In half an hour he made much more clear—to one hearer at least—the accomplishments of the Conference than long columns of newspaper type had done. He told how competition in the development of armaments, which, after all, is the thing that makes most of the trouble between nations, had been stopped by an agreement that placed and kept the nations participating in the Conference on an equal footing.

Other kinds of government information can be put into the air, if the citizens want them. There are probably not less than 250,000 amateur receiving stations at which it is possible to hear one or more government transmitting stations. And so fast are things developing that there may even be half a million. There are 14,000 amateur transmitting stations that could be utilized for local distribution of government broadcasts. There are 530,000 Boy Scouts and officials ready for public service, some as radio operators and some as messengers. If

(*Continued on page* 31)

A Few Thrills from a Steeplejack's Life—Who Can Match Them?

"To 'out-stunt' a rival, I balanced myself on top of a flagpole on a Newark, N. J., skyscraper for at least eight minutes. The wind was blowing so hard that the camera man thought the thing utterly impossible"

HERE is a group of strange adventures such as few men live to tell about, but that are just part of the normal life of a daredevil steeplejack. The men who paint skyscraper flagpoles and perform other tasks on the perilous pinnacles of modern cities never fail to attract great crowds in the streets below, who wonder at their nerve, and how they do it.

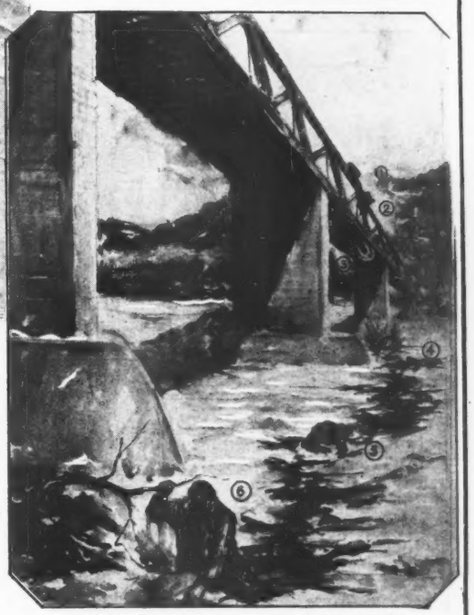
Steeplejack A. Saunders, of Irvington, N. J., is one of America's leaders in this science of scaling impossible places. A few of his most thrilling experiences are told here in his own words and in pictures.

How he does it: "In climbing a pole I use two loops of rope, sitting on one and standing on the other. I raise the lower loop, rest my weight on it, then raise the upper loop, sit in it, and so on"

"The most hazardous stunt I ever did was to climb halfway up the ice of Niagara Falls. Inch by inch, clutching at every piece of jagged ice that offered a firm hold, I pulled my way up a sheer 60-foot wall of rough ice. I was arrested for doing it!"

"In a moving-picture stunt I was one of the crooks being hunted. All had been captured except myself. The only escape, according to the scenario, was to swim to a near-by schooner. I made the trip, and as I reached the schooner, detectives came alongside in boats. I climbed to the top of the mast prepared to shoot if they attempted to follow.

"As they were unable to capture me that way, they blew up the boat. I was hurled from the top of the mast to the water, a distance of about 50 feet, and was picked up unconscious"



"While painting a bridge at the Delaware Water Gap (1) I slipped (2) and fell 40 feet to the frozen river (3), breaking through the ice (4). Injured and exhausted, crawling on the ice and swimming when I broke through (5), I fought my way 100 feet to land (6)

(*Continued from page* 30)

every citizen does not receive as much government radio service as I do, there is no one to blame but himself. The excuse, "I do not know radio," is obsolete, for the army offers free correspondence courses in radio to citizens of the United States.

Among the epochal possibilities that I have lately heard mentioned by government officials are: the broadcasting of important current events for the benefit of public schools; the collection and distribution of information concerning organized criminals at a speed that will bewilder them; and the installation at the national capital of transmitters as powerful as that used at the Chicago Grand Opera, so that citizens everywhere may hear the discussions taking place on the floors of both houses of Congress. If the lobbies and the committee rooms are included, I'll say that will be some system. Though no one has officially suggested it, yet, I should not be at all surprised if, "listening in" some night in a remote country district, with a receiver costing only a few dollars, I should hear the voice of the President himself, talking to all the American people personally and directly about the current accomplishments and policies of our government.

First Prize Awards in Camera Contest

ONE of the winners of the three prizes awarded this month by POPULAR SCIENCE MONTHLY for the best photographs of scientific or mechanical achievements snapped the winning picture in his own back yard!

You, too, can win a prize if you will but keep your eyes open and look about you. Ideas win! Catch them on your film.

Each month $50 in prizes is awarded to the quick-eyed camera fans who know interesting machines and inventive workmanship when they see them. At least one prize winning idea is in your neighborhood somewhere. Hunt it down. Photograph it, including a human figure in the view, and send it in.

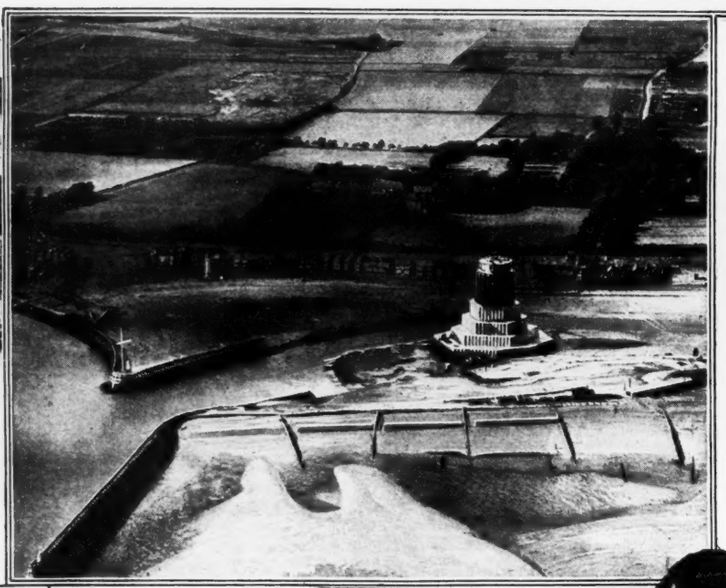
The three winning photographs for April indicate the kind of pictures that will win the prizes for May. They appear in this issue as follows:

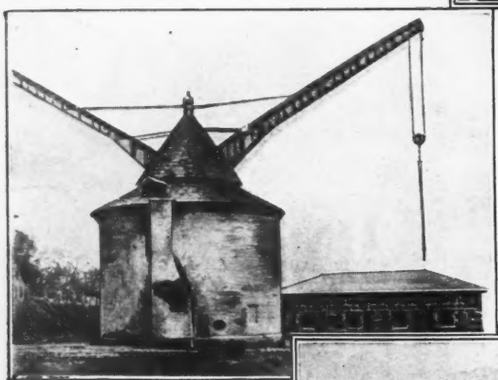
First Prize, $25—Arthur H. Lynch, New York City. Subject—"Amateurs Use Balloon to String Wireless Antennae (see page 60).

Second Prize, $15—Lester L. Sargent, Washington, D. C. Subject—"Spring Acts as 'Other Man' on Crosscut Saw" (see page 44).

Third Prize, $10—J. C. Gordon, San José, Calif. Subject—"Babbitting Jig Casts, Cuts, and Trims Bearings" (see page 28).

AN INDIAN COBBLER, wearing moccasins and dressed in full tribal regalia, earns his living these days by repairing shoes behind a plate-glass window on Broadway to attract crowds of New-Yorkers. He is the son of a chief of the Winnebago Indians of Wisconsin.





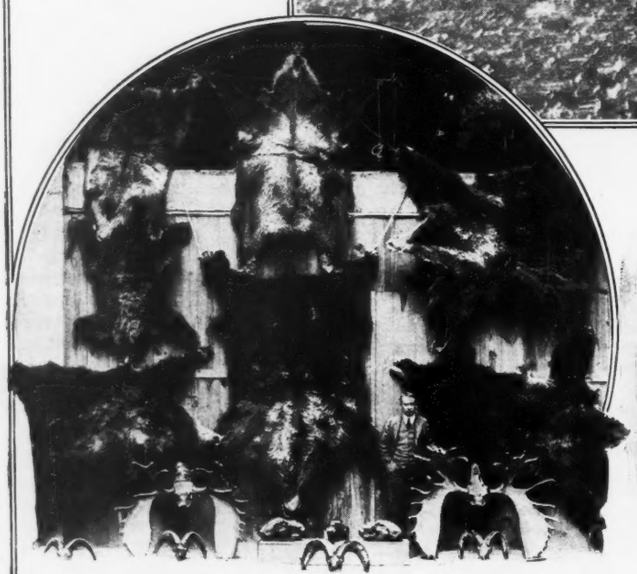
THE OLDEST CRANE in Europe has been located in Trier, on the Moselle River, where it is still in daily use after 509 years of service. It is employed to unload barges along the river bank and is built of wooden beams braced with iron tie-rods. Two arms reduce the strain on the pivot

RISING MYSTERIOUSLY from the harbor of Shoreham, England, one of the famous "mystery towers"—built by the British during the war for an unknown purpose—is rapidly causing the channel to silt up. The general belief is that the tower was erected to test inventions for locating submarines and mines by vibration or electricity

PRESCRIBING PERFUMES to fit the personalities of movie stars is a specialty with Dr. W. D. Duane, Los Angeles physician, who declares the age-old belief of beautiful women that but one certain perfume will enhance her charms, is scientifically sound

Courtesy Pathe News

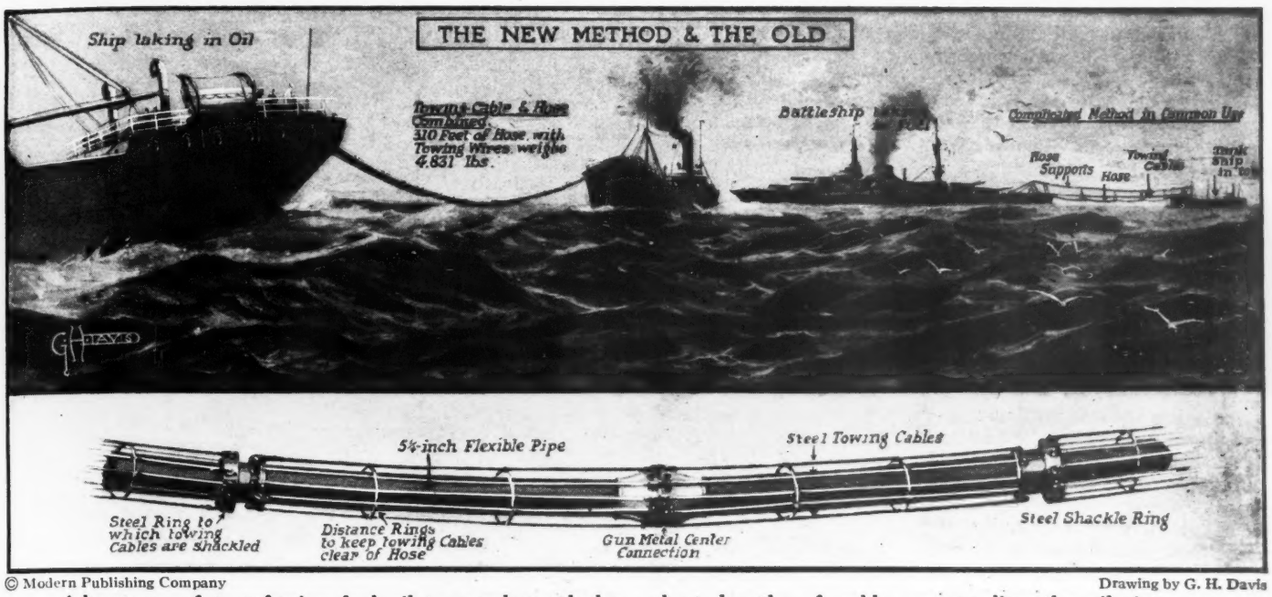
THREE FINGERS was the price paid by L. C. Hutt for his record-breaking success in mounting a motion-picture camera on top of the wing of an airplane in flight. In removing the camera after photographing San Francisco, Hutt's hand was caught by the propeller blade



FOUR MOOSE, eight bears, and six mountain sheep packed the game bag of R. H. Rockwell after a trip to Alaska to secure specimens for a Brooklyn museum

GAS ATTACKS and smoke screens are expected to check crime in Philadelphia, where policemen are being trained in latest combat methods

Novel Hose-Hawser Carries Oil from Tanker to Ship at Sea


THE NEW METHOD & THE OLD
Ship taking in Oil
Towing Cable & Hose Combined 310 Feet of Hose, with Towing Wires, weighs 4,831 lbs.
Battleship
Complicated Method in Common Use
Hose Supports
Towing Cable
Hose
Tank Ship in Tow
5¼-inch Flexible Pipe
Steel Towing Cables
Steel Ring to which towing Cables are shackled
Distance Rings to keep Towing Cables clear of Hose
Gun Metal Center Connection
Steel Shackle Ring

© Modern Publishing Company Drawing by G. H. Davis

Advantages of transferring fuel oil to naval vessels by means of a combination towing hawser and oil hose, as compared with the complicated method of tying the hose to the hawser, are graphically illustrated above. How the short lengths of cable, surrounding the oil-pipe, are shackled to steel rings through which the pipe passes, is shown in the lower picture. Other rings at short intervals keep the cables clear of the oil-hose

BY means of a new flexible combination of towing hawser and oil-pipe, the difficult naval maneuver of taking on fuel oil at sea has been greatly simplified.

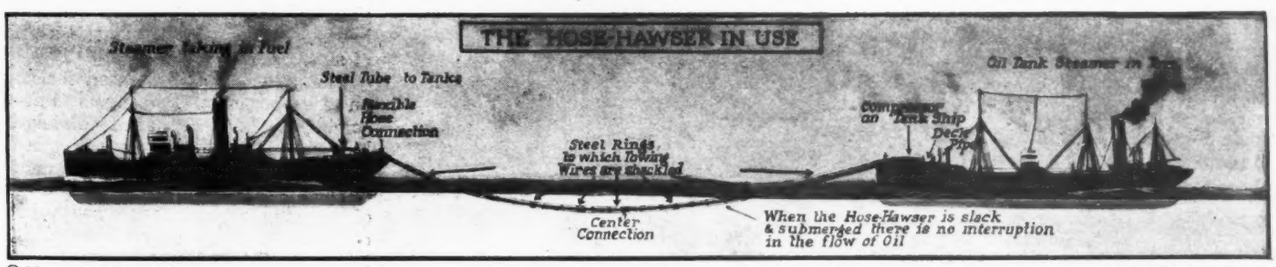
In transferring oil from a tanker to a battleship, it is out of the question for the two vessels to lie alongside and to pass a short pipe between their tanks. Even in a comparatively calm sea, the pitching of the boats would break the hose and might seriously damage the plates and bulwarks of both ships.

In transferring oil, the ship receiving the fuel is taken in tow by the tanker, so that a uniform distance is constantly maintained. In the past the oil-hose usually has been tied to the towing hawser with short slings of rope. It has been difficult to pass this awkward double line between the ships, and the transfer of oil has been frequently interrupted by the kinking of the hose or by the slipping of the hose from the cable.

In the new invention, small steel cables are arranged in parallel about a flexible hose. Metal rings protect the hose from abrasion by the cables. The combined strength of the ropes is equal to that of the ordinary towing hawser, and the oil is thus pumped through the center of the towline. As there is only one line to handle, it is said that the lines can be passed by three men in less than half an hour.

The oil-line is made in comparatively short sections, with each length coupled to the next by shackles fastened to the steel rings through which the oil-pipe passes, and by which it is supported. The hose sections are connected with a universal joint. The line is made in sections for convenience in stowing, since it is too stiff to wind on a drum, and is laid along the vessel's deck when not in use.

The combination of oil-hose and hawser weighs about 15½ pounds a foot, and it is said that by its use oil can be transferred in any weather, while a speed of 16 knots an hour is maintained by the towing vessel.


THE HOSE-HAWSER IN USE
Steamer taking in Fuel
Steel Tube to Tanks
Flexible Hose Connection
Steel Rings to which Towing Wires are shackled
Oil Tank Steamer in Tow
Compressor on Tank Ship Deck
Center Connection
When the Hose-Hawser is slack & submerged there is no interruption in the flow of Oil

© Modern Publishing Company Drawing by G. H. Davis

Flexibility of the new hose hawser eliminates the necessity of maintaining uniform distance between oil tanker and the vessel receiving fuel. Even when the line is slack, there is no danger of kinking or interruption of the flow of oil

Convertible Firearm Is Combination Pistol and Rifle

A NEW .22 caliber repeating rifle, invented by Major Anthony Fiala, noted explorer, can be converted in a few seconds to a high-grade target pistol or into a short-barreled pocket pistol which is ideal as a weapon of defense.

These changes are accomplished by equipping the rifle with a detachable butt-stock, and by making the barrels so that they can be readily unscrewed from the frame. As most of the expense of making a gun is in the frame and breech mechanism, the manufacturer of the new gun is able to sell the whole combination, consisting of the frame, three barrels, and detachable butt-stock, for the price of one gun.

It is claimed that this combination furnishes the complete outfit of firearms needed by the farmer, trapper, or camper. The rifle will effectively dispose of stray cats and dogs, and is effective for varmints and all small game. The target pistol serves as a hunter's holster weapon or camper's companion. The pocket pistol is very compact and weighs about 27 ounces.

By means of detachable barrels and butt-stock the rifle is converted into a pistol

Long and short pistol barrels, a rifle barrel, detachable butt-stock and the frame make up a complete outfit

Phonograph Records Catch Radio Messages

ONE hundred words a minute! That is the speed at which press reports from Europe can now be transcribed at radio stations through the use of an automatic recording device that operates on the principle of a phonograph.

After incoming signals have made a record on the phonograph running at high speed, the wax cylinders are placed on a reproducing machine, running much slower. In this way the dots and dashes may be deciphered and transcribed slowly and accurately by the radio operator.

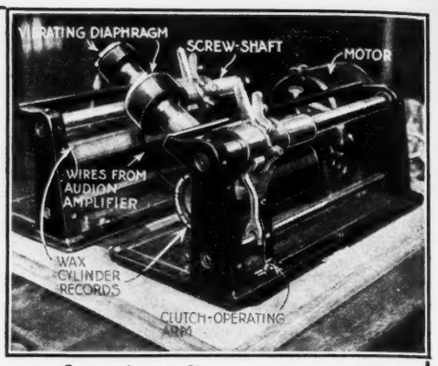
Some such device has long been needed, since the world's record for receiving radio by ear is slightly less than 50 words a minute, in spite of the fact that many mechanical senders will transmit at 100 words a minute or even faster.

To provide for continuity of signals, so that there will be no break in the message while the operator is inserting a new cylinder in the phonograph recorder, a dual control is provided. There are two telephone receivers, each directly connected with a phonograph.

Of course both of these telephones operate simultaneously, regardless of whether the cylinders are revolving or not. But the arm that carries the recording needle over the surface of the cylinders is fitted with a short extension that engages a little lever controlling the clutches that operate the drums carrying the cylinders. When one cylinder is thrown into operation, the other is automatically thrown out. But since the movement of the recording devices is slow, the one about to be disengaged makes several revolutions after the new cylinder has begun to receive signals.

In this way the last few signals on each record are duplicated at the beginning of the next, and operation of the device is continuous.

An adjustable governor on the driving motor, similar to those in the ordinary phonograph, permits the device to be operated rapidly in receiving the signals and slowly when the operator wishes to transcribe them on the typewriter.



Incoming radio messages are automatically recorded on wax cylinders

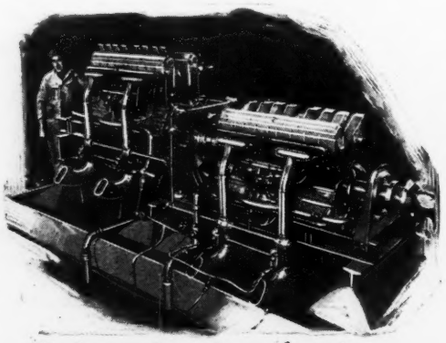
The phonograph cylinder containing a record of a radio message is placed in a reproducing machine, from which the operator transcribes the message

First All-Metal Transatlantic Plane Will Carry Twenty

TO realize the dream of a giant air express, giving regular passenger service across the Atlantic, an all-metal airplane has been constructed in the Paris plant of Louis Breguet, noted French aeronautical engineer.

This new air leviathan, which is awaiting finishing touches before embarking on its trial voyage, weighs 13 tons, and has a wing surface of 250 square meters. Its most striking safety feature is its power plant, which consists of four motors, synchronized and geared to a single propeller, yet acting independently so that if one motor breaks down, the other three will continue to function. They will generate 1250 horsepower and will move the plane at a speed of from 160 to 190 miles an hour.

Metal is used throughout the fuselage, latticed girders of duralumin forming the frames, and the longerons, or longitudinal members, being of duralumin tubes. From the maker's preliminary figures this construction will give one of the lightest large-size machines ever built, since the weight empty is only 6600 pounds for a 20-passenger plane, and the weight loaded amounts to 7700 pounds. Both lightness and safety have been found essential for success on the long runs between Paris and Algiers.

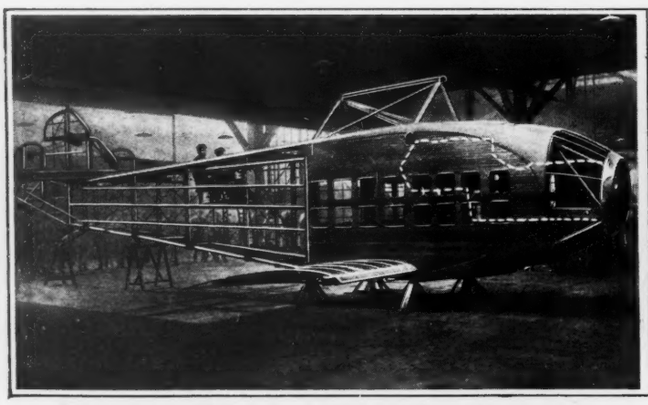


The four engine units are geared to a single propeller. If one fails, the others continue to function

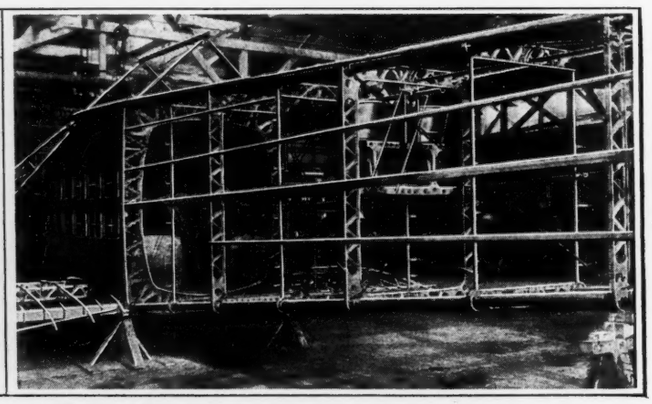
Not a piece of wood or cloth is to be found in the entire plane, except for the propeller. This all-metal construction eliminates two of the greatest dangers—fire and the tearing of the cloth-covered fuselage, dangers that have hindered passenger-airplane development.

The duralumin girders have been stamped out of flat sheets and corrugated to withstand loads in compression, somewhat after the fashion of Zeppelin girders. Instead of crossing each other, however, the lattice bars make a series of zigzags.

The pilot's seat is placed far back on the fuselage. Passengers will be carried in a large cabin immediately behind the engines in the very nose of the plane, their seats being placed on top of the plane's gasoline tanks. The walls of this cabin are also covered with sheets of corrugated metal only 0.015 inch thick, instead of wood or fabric, although fabric will be used in the remainder of the fuselage.

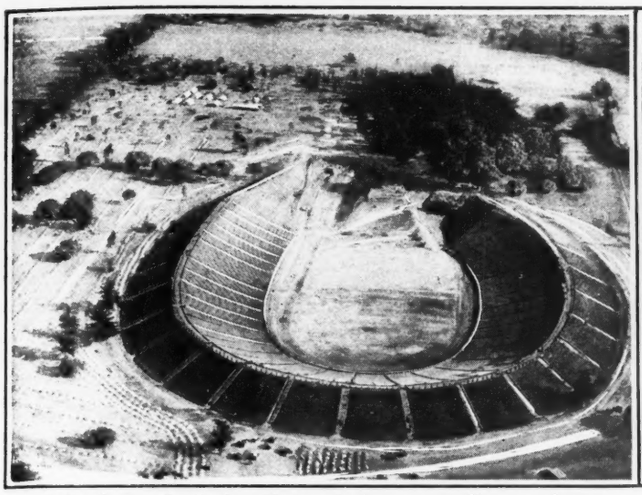


The position of the motors in the nose of the plane is indicated by the dotted lines

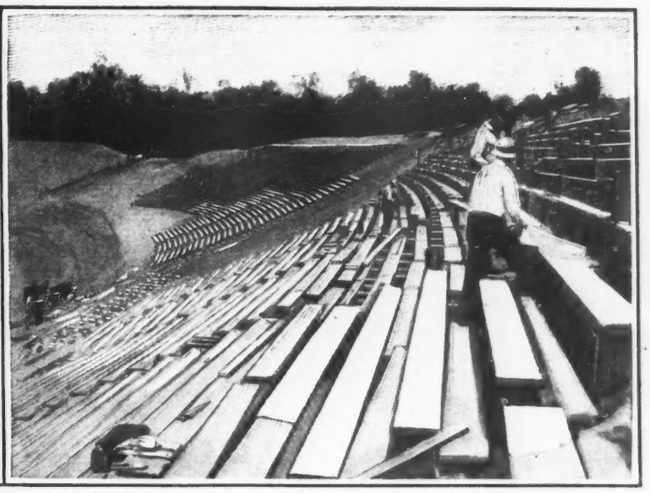


Lattice girders of duralumin form the frames of the fuselage. No cloth or wood is used in construction

New Leland Stanford Stadium Is Built to Last 20,000 Years



Leland Stanford, Jr., University's new stadium—a huge mound of sand, gravel, and stone, such as glaciers deposit



Circling the inner side of the bowl are 65 rows of wooden seats, accommodating 65,000 spectators

BUILT of gravel, sand, and water-worn stones—materials such as a glacier carries and deposits—the vast new stadium of Leland Stanford, Jr., University, will outlive the world's greatest amphitheaters, according to the estimates of engineers in charge. They declare that the big bowl should stand up under the wear of time for 20,000 years. Terminal moraines, or glacial deposits, they point out, have resisted the action of the elements for many thousand years without materially altering their shape.

The stadium is in the form of a huge horseshoe mound. Lining the inner sides of the mound are 65 rows of wooden seats, accommodating 65,000 spectators.

To finish the stadium in time for the big games of last autumn, all construction records for this kind of work were broken. The plans were drawn, the funds raised, and the work completed in eight months, while the actual building work was finished in 150 days. In this time 230,000 cubic yards of earth was excavated and repiled, and 800,000 board feet of lumber used in construction.

The dimensions of the stadium are 562 feet by 355 feet. The playing-field is 23 feet below the original surface of the ground, and the top of the embankment rises 36 feet above the original level.

The cut-and-fill method of construction was adopted in order that the stadium might withstand the severest earthquakes. One end was left open to provide space for a 220-yard straightaway track without using a tunnel, as is usual in other stadiums, and also to provide better ventilation during periods of warm weather, which frequently occur late in November in this section of California.

Leland Stanford, Jr.'s new amphitheater is the second largest stadium in the United States, only exceeded in capacity by the Yale bowl. Since it is claimed that 20,000 additional seats could be erected by filling the open end of the Stanford bowl with a concrete and steel grand stand, this California playfield may eventually become the largest in the country.

Baby's Milk Comes, Stirred by Motor, In "Thermos Bottle" Cars

REPLACING the old-time rattling milk-cans, giant "thermos bottle" cars are now keeping milk sweet and cold as it travels from the dairy to the table.

The new milk-bottles on wheels consist of great 2500-gallon steel tanks, lined with glass. Two of these tanks are mounted on each car and each is equipped with a motor-driven agitator to stir the milk at the terminal, just before the tanks are emptied, in order to assure uniformity throughout the contents.

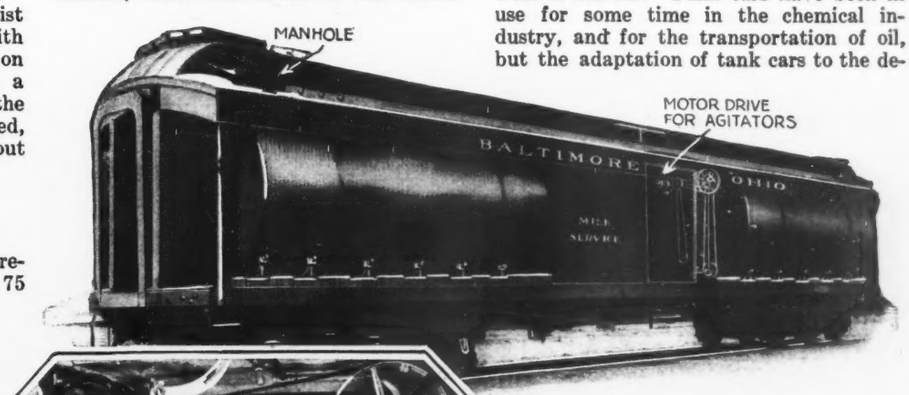
Transportation Costs Reduced

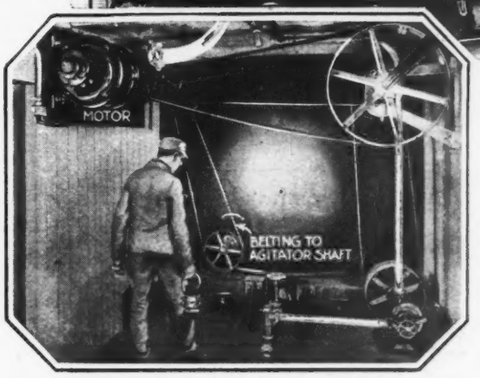
The use of the cars, it is claimed, has reduced the transportation costs of milk 75 per cent. A shipment of milk that would usually require seven cars loaded with 10-gallon cans, may now be transported in three tank cars.

The milk is chilled to a temperature between 38 and 40 degrees before being pumped into the cars, and in a rail journey of 107 miles the temperature rises only two degrees. To increase the refrigeration efficiency to the maximum, the tanks are furnished with manhole openings that are closed by airtight swivel doors.

The tanks are of steel, lined with glass, which is fused into the metal by a special process of applying extreme heat. The rest is a smooth, unbroken glass coating that will stand rough usage because of the steel backing. The tanks may be cleaned with hot water and a soda solution as readily as a glass receptacle.

When mounted, the containers are securely fastened by lugs embedded in heavy timbers, which are bolted to the timber-work of the car. This arrangement is further strengthened by tie bands running over the tops of the tanks and bolted to the sides of the car. Tank cars have been in use for some time in the chemical industry, and for the transportation of oil, but the adaptation of tank cars to the delivery of milk is something distinctly new.





How motor and pulley connections to the agitator are arranged at the end of the milk-tank

HOW TANKS ARE MOUNTED

At each end of the car is mounted a 2500-gallon glass-lined steel tank. Beside each tank is the motor-driven agitator that stirs the milk, as shown in the phantom view above

A further saving arises from the better drainage from large tanks. In emptying a 10-gallon milkcan, a quarter of a pint of milk clings to the sides of the can and is lost. In a 5000-gallon load this waste would amount to 150 gallons, while under the new method the average loss is only two gallons.

Diving Truck Resumes Journey Undamaged

MARINE salvage methods had to be used to get a two and one half ton truck back on the road after it had plunged through the center of an old bridge spanning a deep river near Paterson, N. J. Fortunately for the driver, when the rear wheels broke through, a front bumper caught on a plank that was strong enough to support the truck. The water below was over 15 feet deep.

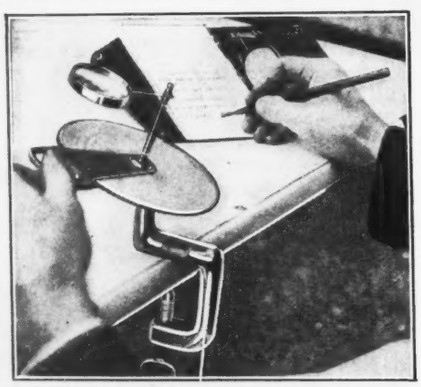
Before the truck was chopped loose from the bridge, two scows were floated into position, one on each side of the truck, and the chassis was lashed to a strong beam passing between the scows, where it was supported by a hastily improvised crib of railroad ties. The supporting plank was then cut away, and the truck floated to the bank.

Here it stood for four days, with the water covering the engine. In spite of the accident and this prolonged soaking, the salvaged truck finally made the return trip to Paterson under its own power.

Metal Slide Rule Is Accurate and Easy to Read

A METAL slide rule for the pocket, that does not require months of practice before its results can be accepted with confidence, has been perfected after 10 years' study by Louis Ross, an engineer of San Francisco, California. The advantages claimed for the instrument are greater accuracy—up to one twentieth of one per cent—and the avoidance of errors common to wooden rules due to warping, swelling, and shrinking.

In addition to the logarithmic scales common to slide rules, this calculating instrument has a 360-degree protractor, scales of radians and of cubes, and complete trigonometric scales from 0 to 90 degrees for all six functions. Two flush metal dials, scaled with fine engraved hairlines filled with a purple pigment rotate concentrically under a transparent arm. A magnifier facilitates interpolation and makes the readings appear larger than ordinary typewriting.



Equipped with a magnifying glass, the circular slide rule is easily and accurately read

The scales are numbered plainly, like a foot-rule, so that any one can read them without practice. When a problem is set under the arm, one arrow shows the answer, and a second arrow the proof.

ANCIENT Chinese porcelains cannot be duplicated because the coloring matter used came from mines now exhausted.

Powdered Chemical Compound Thaws Frozen Pipes

INORGANIC chemicals in dry, powdered form, so combined in a recent patent that gases and intense heat are generated when the powder is mixed with water, will thaw out frozen drain-pipes far more quickly than a blowtorch, it is claimed.

The solution is heavy, and when poured into an obstructed drain it will seek the obstruction. Its heat, the agitation of bubbling gases, and the nature of the chemicals finally produced are said to remove such stubborn stoppages as grease and matted rags.

A can of this material placed upon a 100-pound cake of ice will melt a hole through the block in eight minutes.

WHEN lightning struck the power line feeding one of the electrically driven pumping stations in Minneapolis recently, the circuit breakers were thrown out and two huge centrifugal pumps stopped suddenly. The resulting water hammer burst the bonnet of a 42-inch valve in a header at the plant, and also burst 16 feet of lock bar on the steel delivery pipe half a mile away. Newspapers said the pipe line had been "struck by lightning."

Portable Canvas Canoe Folds Up Like a Suitcase

A FOLDING canoe in which seaworthiness has not been sacrificed to portability has been recently invented by Victor Holmstrom, an enthusiastic hunter and fisherman of Detroit, Michigan.

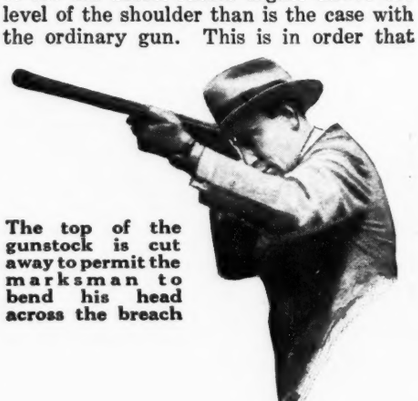
He desired a boat that could be handled in the water with some comfort and security, but that might be carried on a street-car without a justifiable protest from the conductor.

The canoe is made of canvas stretched over a folding frame. In the water it is rigid and strong enough to handle with the same ease and safety with which one paddles the usual cedar craft. It is light enough to carry overland without difficulty to distant lakes, and when encased in its cover it is no larger than an ordinary piece of hand baggage.

Freak Gunstock Made for One-Eyed Trap-Shooter

CAN you shoot a gun from your right shoulder, aiming with your left eye, and hit the mark? A right-handed sportsman who has lost the use of his right eye can shoot nearly as accurately as before by using a freak gunstock specially made to permit alinement of his left eye with the gun sights. The peculiar arrangement of the gun will work equally well for a left-handed man who must aim with his right eye.

The stock is cut away deeply on top to allow the marksman to put his head well across the breech, while the length and exaggerated drop of the stock are required to lift the barrel rather higher above the level of the shoulder than is the case with the ordinary gun. This is in order that the left eye may be brought in the rear of the sight without too much strain on the muscles of the trap-shooter's neck.

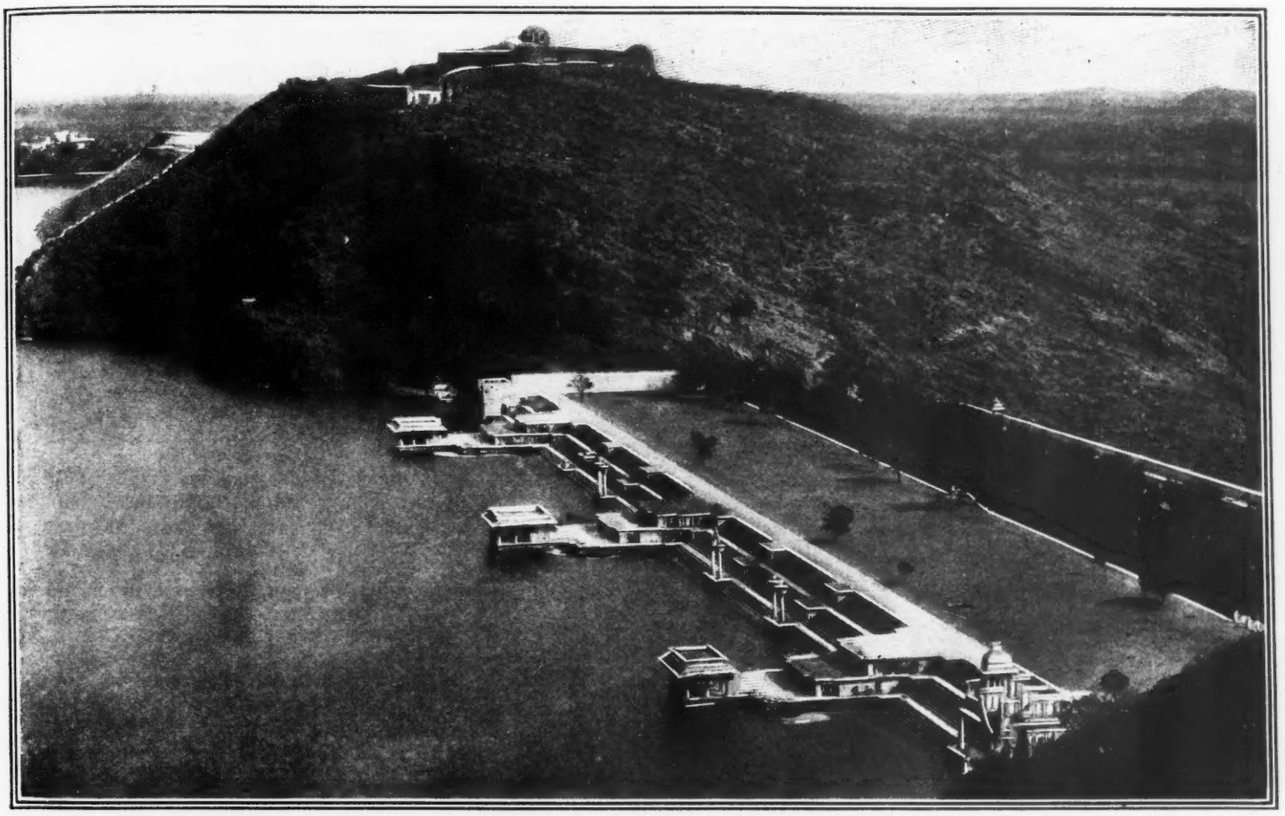


The top of the gunstock is cut away to permit the marksman to bend his head across the breech

It is claimed that a shooter can more easily change his stock than his habits of handling a gun, and that really accurate shooting is possible for the sportsman with the queer weapon.

Vast Marble Dams, Hidden for Centuries in Hills of India, Are Unsung Triumphs of Engineering

Thousand-Foot Walls Imprison World's Largest Artificial Lake



Imprisoning the deep waters of Rajsamand—an artificial lake 30 miles in circumference—stands a wall of polished marble, an unsung masterpiece of engineering skill, built by an Indian prince in 1661 to prevent disastrous famine and pestilence

HIDDEN in the Aravalli mountains of Rajputana, the "heart of India," among fairylike palaces and grim fortresses, lie two vast artificial lakes imprisoned by great dams built entirely of white, polished marble. These dams—Rajsamand and Jaisamand, constructed in the seventeenth century by rulers of the little kingdom of Mewar to save their people from famine—are triumphs of engineering and art; yet they have remained unsung and almost unknown throughout the centuries.

Picture a dam nearly three miles long, rising 40 feet high from base to spillway, impounding the waters of a mountain stream into an artificial lake 30 miles in circumference, and built entirely of gleaming marble. Such is Rajsamand, magnificent with marble steps and pavilions. This wonder of engineering was started by the Rajput ruler, Rana Raj Singh, in 1661, following three years of frightful drought and famine, and was completed 20 years later. Vast surrounding areas, once dry and waterless, are now fertile rice and grazing fields.

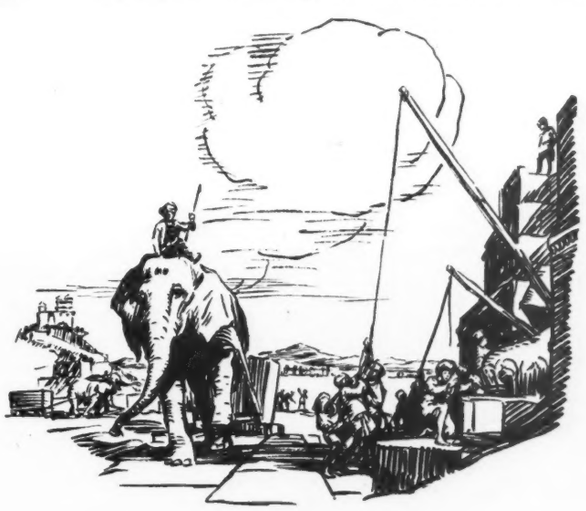
Thousand Feet Long

Close by is Jaisamand, built in the years 1681 to 1700 by Rana Raj Singh's successor, Rana Jai Singh. Jaisamand is one of the rare sights of India. From the approach over a distant mountain pass, its line of white marble dam, 1000 feet long and 98 feet high, appears like a phantom band, locking in the artificial lake 95 miles in circumference—said to be the largest artificial lake in the world.

Americans are justly proud of their achievements in engineering; yet to find an artificial body of water at all comparable with those formed by Indian princes 250 years ago, we must go to the Gatun Dam at Panama. To find a higher dam than Jaisamand, we must go to the Roosevelt project built by the United States' Reclamation Service in Arizona.

Without blueprints or complicated mathematical calculations, without power machinery and dynamite, without even a derrick, the rajahs accomplished a tremendous work, designing a structure that has withstood the elements for centuries.

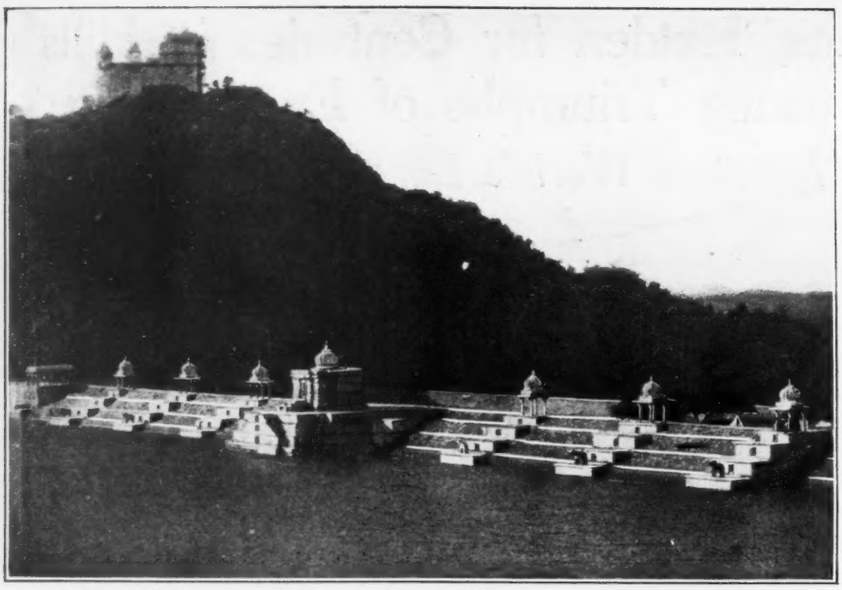
On the score of beauty, certainly no modern structure of this sort can compare with the Indian dams. Not only are they of solid marble—which, by the way, is the common stone of India—but they are cleverly decorated with minarets, pavilions, and sculpture.



Trained elephants performed the work of modern railroads, motor-trucks, and derricks, dragging great blocks of marble to the construction site

How Dams Were Built

The construction methods used by the rajahs bore little resemblance to the engineering equipment of modern industry. A near approach to their derricks is our primitive wooden "well-sweep." With these sweeps the marble blocks were hoisted into position, when inclined planes could not be used. The power of the king was absolute. If he chose, he could commandeer every artisan and coolie in the kingdom, to say nothing of beasts of burden; so that the surrounding country, strewn with marble boulders, must have resembled an army encampment as it resounded to the sound of hammer and chisel.



Jaisamand dam, with flights of white marble steps and fairylike pavilions, impounds a mountain stream into the largest artificial lake in the world

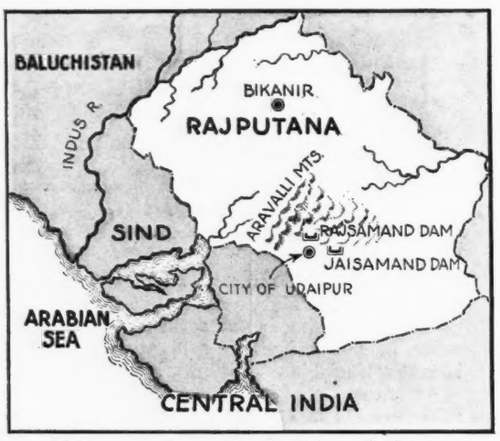
Trained elephants, camels, bullocks, and donkeys by the thousand dragged the material to the building site.

Excavating was done with large, sharp hoes, the earth being transported in stout fiber baskets slung pannier-wise across the animals and on the heads of coolie men, women, and even children. All worked in that leisurely, but regular procession, peculiar to the East, where time is not and obedience is law.

Twenty Years of Labor

Twenty years were required to complete each of the dams, which cost $5,000,000 at a time when labor was unbelievably cheap and the material lay in convenient quarries. Such susl tained endeavor, however, can be matched in Western countries—notably in the building of the medieval cathedrals.

After all, the wonder of the Indian dams is in their conception and plan. For while the ancients erected many great dams, these were usually built far more massively than was necessary. The bases of the earliest dams were four times the height, and even the Romans reduced this ratio only from three to one. The earliest masonry dam of which the ruins still exist was built by Menes, king of Egypt, nearly 6000 years ago. It diverted part of the waters of the Nile into a canal, and protected the Egyptian city of Memphis against flood for 45 centuries. It was kept in repair by the Egyptians, Persians, Greeks, and Romans successively.



This map shows the location of the two dams in Rajputana

The largest dam of the ancient world was built in Yeman, Arabia, about 1700 B.C. It was two miles long, 120 feet high, and 500 feet wide at the base. After 2000 years it collapsed, causing a disastrous flood. This dam contained nearly 15,000,000 cubic feet of masonry, and was built on a base to a height proportion of four to one.

Slopes Formed in Steps

The ruins indicate that all of these ancient dams were designed with level tops, and with the front and back faces sloping in opposite directions. The slopes were not smooth surfaces, but formed in series of small steps so that if the water overflowed, the steps on the downstream face would check its velocity, preventing the overflow from undermining the foundations of the dam. They were usually of solid masonry, but where earth fill was employed, it was used very much along modern lines.

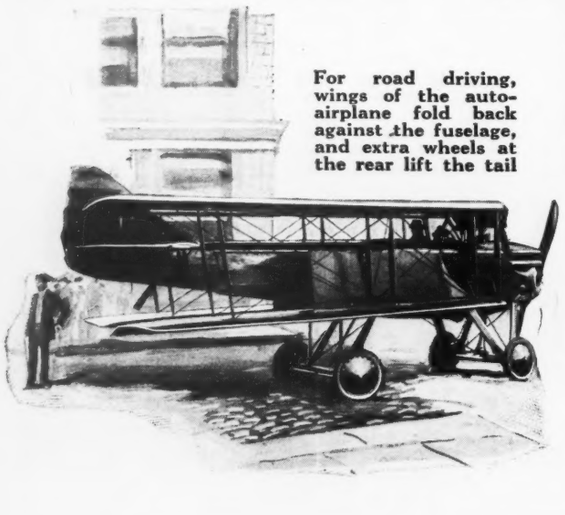
In a 50-foot dam built near Fayum, Egypt, about 500 B.C., the core is composed of small stones about the size of modern "crushed stone" embedded in clay; the next layer is of limestone blocks piled up in the fashion of our modern riprap work, and the final layer is cut stone in horizontal courses, each course receding from the one below to form the series of steps.

The Indian dams are on a different plan from the ancient structures in Egypt and Mesopotamia. Rana Raj Singh had never seen these, nor did he have the benefit of hundreds of years of experience tabulated and codified in the engineer's notebook. Largely "going on his own," he worked out another successful type of dam with remarkable prevision of modern engineering practice.

For example, since the basin behind the Rajsamand dam is very deep, the rajah realized that his structure must withstand great water pressure when the basin filled. He solved the problem just as modern engineers do. He built his dam in the form of a segment of a circle, so that the structure acts like an arch, buttressed by the hillsides. The walls are only a trifle thicker than the engineer of today would build them.

Biplane Folds Its Wings to Speed Along Highways

WHEN the roads are bad, a new combination auto and airplane of French design simply unfolds its wings and flies.



For road driving, wings of the auto-airplane fold back against the fuselage, and extra wheels at the rear lift the tail

When the air is bad, the machine folds its wings back against the fuselage and an extra pair of wheels in the rear drop to the ground for a spin along the road. Since these wheels lift the tail well off the ground, the fuselage, steered by an aerial rudder, can travel the highways like any motor-car, using a little extra precaution in rounding sharp turns. When not in use, the rear under carriage folds up inside the fuselage.

A small 10-horsepower auxiliary engine supplies the power for road travel and a car-type drive with four speeds and a reverse transmits the power to the two main airplane wheels.

Aerodynamically the new plane is of the tractor type, and is intended for sport use. It will find favor, it is expected, with those who like to fly for amusement, but who live at a distance from large fields, and accordingly must "taxi" along the roads to reach the nearest airdrome. The model is said to possess fair speed and carrying power.

For flight, the machine unfolds its wings and draws up its rear wheels

Normally the machine proceeds tail first along the road, although the reverse drive enables it to travel nose first if necessary. It is capable of a road speed of 35 miles an hour.

Light Burns a Minute to Save Your Shins

ELECTRIC lights that stay lit for a minute after they are turned off at the switch will be appreciated by any one who has ever stumbled over a chair on the way to bed or cracked his head on a half-open garage door. A thermostatic element keeps the current on for 60 seconds after the switch is opened.

turn off light

close up and get away

light goes out

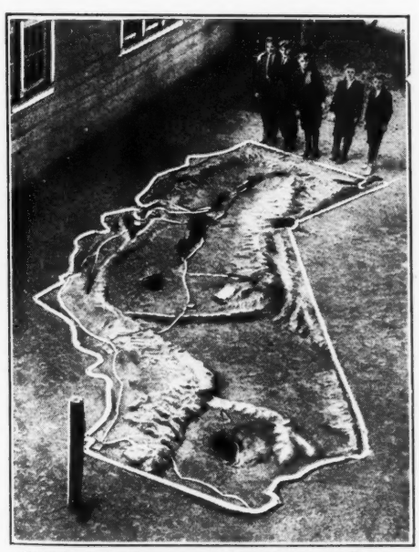
The element does not act as a slow-moving contact to break the circuit, but forms a spring latch, which, when cold, holds two spring leaf contacts together, releasing them after it has been heated to a certain temperature.

Throwing a small resistance unit into the circuit by pulling the socket chain heats the thermostatic latch. This heating unit, together with the lamp, is cut out of the circuit by the action of the spring leaf switches, and remains off until the "on" chain lights the lamp.

Relief Map of Concrete Built in Schoolyard

IN the schoolyard, seventh and eighth grade students of San José, Calif., have constructed a concrete relief map of their native state, upon which the mountains, lakes, valleys, and rivers are built accurately to scale. Details and minor topographical features are shown insofar as the size of the map permits.

The map is said to be of value in giving the students accurate knowledge of the geography of their own state. It is, of course, far more graphic than the printed maps. In depicting a state highway, for example, a heavy wire is run from city to city. The task of laying such a wire fixes the location of the road in the students' minds. Real water actually flows in the miniature rivers and stands in the lakes.



Children built mountains, lakes, valleys, and rivers in concrete—all to scale

Rattleproof Window Is in Hinged Sections

IN the newest rattleproof window for the motor bus, the pane is divided horizontally into two hinged sections. One half swings up and the other down, and both may be locked in any position.

Perfect ventilation, simple design, and light construction are claimed for the new window. The idea underlying the improvement is the use of hinges identical with those employed on wooden windshields for motor trucks. These lock automatically in desired position and hold the windows open as well as closed. As there are no loose parts, rattling is impossible.

Your Trunk Can Be Office Desk on the Road

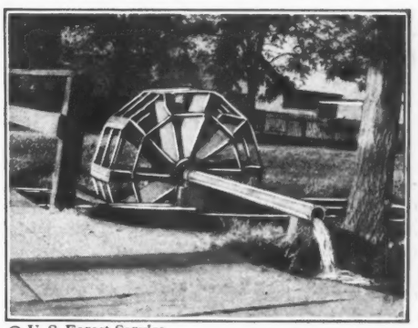
ANY salesman or other traveler who is much "on the road" can convert his wardrobe trunk into a convenient desk by carrying a small drawing-board and a hinged metal brace that supports the board against the trunk. When the trunk is packed, the board fits into the compartment, and if space permits, the desk may be supplemented by compact fittings that make the trunk a complete office.

Two drawers provide room for an electric light, a small fan, a typewriter, necessary reference books, and a small filing cabinet. With these aids the daily letter to the home office is easily prepared.

Water Lifts Itself to a Higher Level on Wheel

WATER rises above its own level when ingenious water wheels now often seen in North Yakima, Wash., are placed in a moving stream. On the irrigation ditches that flow through the town, these portable wheels are used to provide water for some special spot—such as a front lawn—when it is not desired to dig a cut-off from the main ditch.

The mechanism is a common waterwheel, except that narrow planks are nailed on the back of the paddles to form boxes about one inch deep. When the paddles leave the stream, some water is caught in these boxes, and as the paddle rises it runs down the blade into the hollow axle. From the axle the water enters the delivery spout.

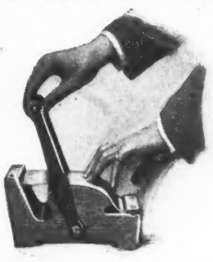


© U. S. Forest Service

Shallow boxes dip water from the stream

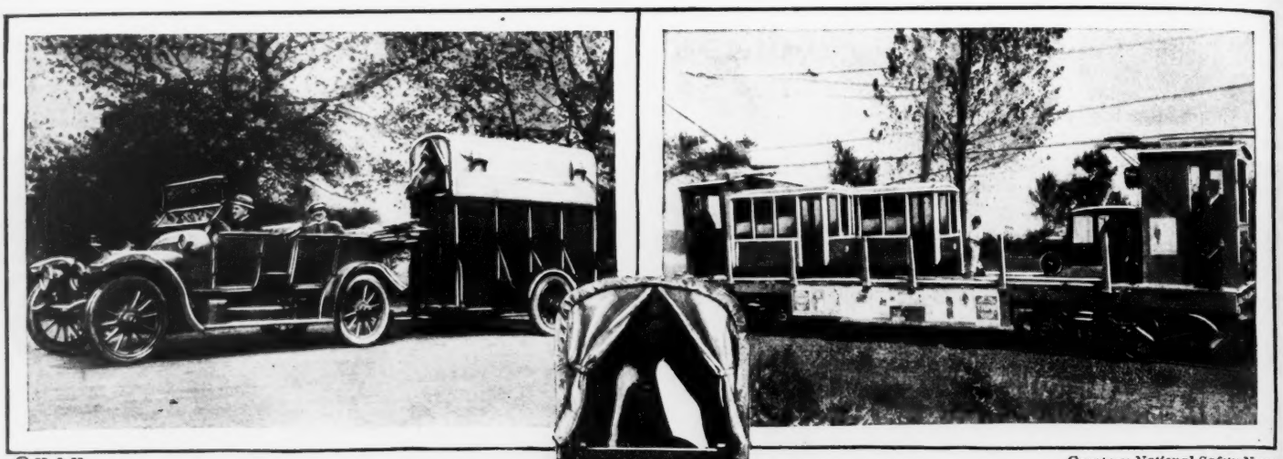
Tracing-Cloth and Block Roll Cigarettes

CIGARETTES are rolled with the aid of a solid wooden block and a strip of tracing-cloth in an ingenious new device of French invention. The tobacco, preferably of the shredded rather than the grainy variety favored by those who "roll their own," is placed in a fold of the tracing-cloth. As the handle of the apparatus is pulled forward, the tobacco is rolled in the moving fold of the cloth.



A cigarette paper, moistened along one edge, is placed in the center of the block, and as the roll of tobacco passes above it, the paper is wrapped about it and gummed. The handle is pulled all the way down, and at the bottom a neat cigarette drops out.

BY EATING the poisoned bait set for coyotes, hungry mice are interfering with the work of the government poison squad in Wyoming. Poisoned grain was scattered about to kill off the mice, but they proved too numerous to destroy in such a simple manner.



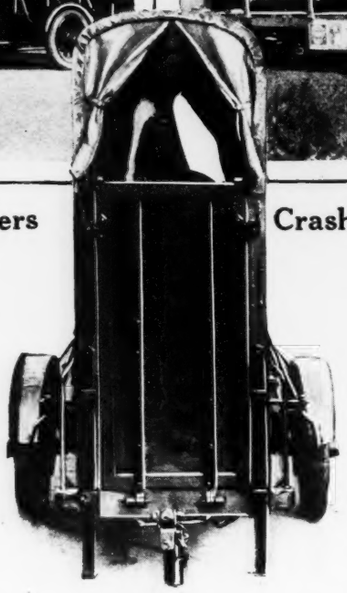
© K. & H.

Race Horses Ride in Special Trailers

WHEN the first automobiles broke down, the cry was, "Get a horse!" Now the situation is reversed, and the horses are being carried by cars. A pneumatic-tired trailer, in which a race horse can be carried from one track to another, has recently been brought out in England.

The vehicle is virtually a narrow box stall on wheels fitted with every comfort to make traveling easy for the horse, and to prevent it from being frightened or tired by travel. The ends of the trailer drop to the ground to provide two inclined platforms by which the horse can enter or leave the stall.

Fox hunters who wish to attend meets in various parts of England are finding this invention a means of carrying their favorite mounts with them.



Traveling in a rubber-tired limousine is easy on the horse's nerves

Courtesy *National Safety News*

Crash! Reckless Drivers, Take Notice!

WHAT is likely to happen when an automobile carelessly crosses behind a moving car? A graphic answer to the question was given recently by a moving safety exhibit mounted on a flatcar that repeated its lesson at frequent intervals along the trolley tracks of New Haven, Conn.

The exhibit consisted of two miniature street cars and an automobile, and was arranged so that the cars could be operated in both directions while the auto crossed from one track to the other.

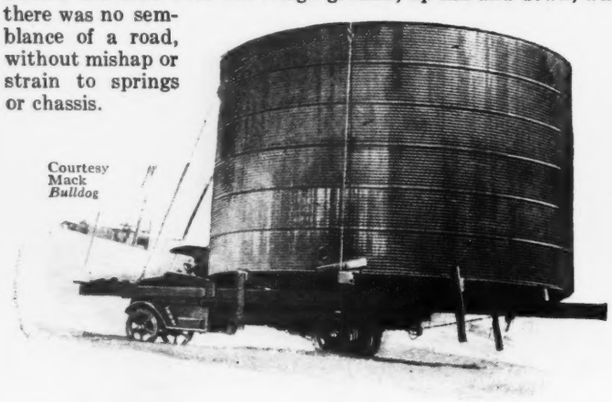
The first car missed the auto, but the second car invariably struck it. As it did so, the radiator caved in to make the "wreck" realistic. For the next demonstration, the auto was pulled back into shape by a rope attached to the hood.

THE new Hudson River bridge will be the first large bridge to be weatherproof. That is, its steelwork will be so completely enclosed with bronze to exclude rain and moisture that the annual cost of repainting—the most serious item in the upkeep of a big bridge—will be reduced to a minimum. Only about 15 per cent of the structure will be exposed to the weather. If the entire surface were exposed, it is estimated that the annual painting bill would be nearly $500,000 a year.

Motor Truck Outdoes the Ant

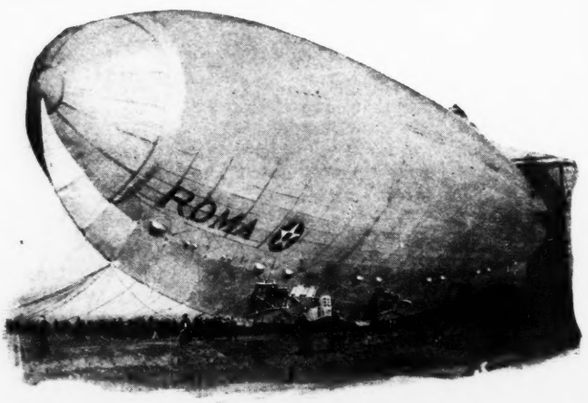
A 1500-gallon oil tank, 30 feet in diameter and 24 feet high, was not too bulky a load for the five-ton motor truck that recently carried the tank several miles over the open country of the Elk Oil Fields, Calif. The truck is a stock model, without special body or trailer.

The tank was so large that it was necessary to support the load on heavy timbers that extended far beyond the hood in front, and some distance beyond the chassis in the rear. In addition, a five-foot timber was bolted vertically to each end of the hindmost transverse support. These timbers were for emergency use, in case the car should start to overturn; but the five-ton truck carried the load over the rough ground, up hill and down, where there was no semblance of a road, without mishap or strain to springs or chassis.



Courtesy Mack *Bulldog*

With the aid of heavy timbers as extension supports, the truck was able to haul this 1500-gallon oil tank



Army's New Dirigible Passes Tests

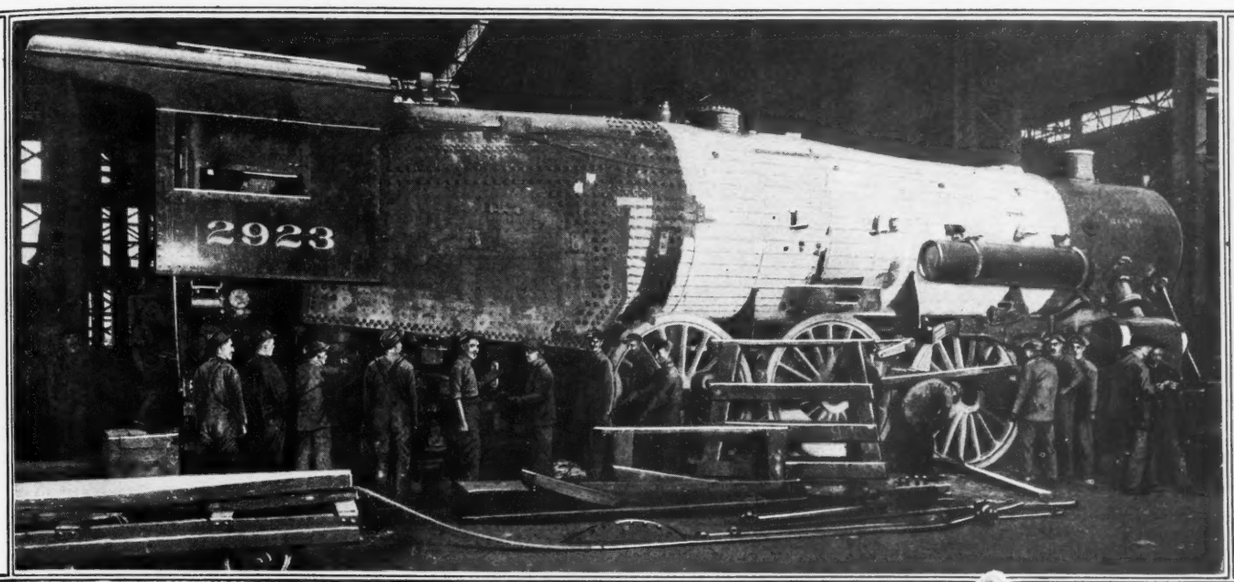
SUCCESS marked the recent trial flight of the semirigid airship *Roma*, shipped knocked-down from Italy, and assembled by airmen of the American army at Langley Field, Va., for the coast defense service. The dirigible remained in the air for three hours and 37 minutes, making a 260-mile cruise above the waters of Hampton Roads.

The *Roma* is of a type more familiar in America than the ill-fated ZR-2, which was a rigid ship on the lines of the Zeppelins. The metal framework is reduced to a minimum, and is confined chiefly to the fin-shaped keel below the gasbag. As the *Roma* is much lighter in weight, it is slightly faster than the ZR-2, having a maximum speed of 70 miles as against 65. However, the cruising radius of the ZR-2 was nearly four times as great. The *Roma* can work over a radius of 1500 miles.

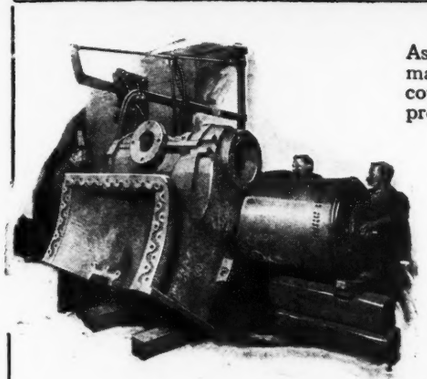
Will Cables Guide Intercity Planes?

CABLES 400 feet in the air to guide airplanes during trips between large cities, is the proposal now advanced by British aviation experts for creating greater safety in intercity air line travel. The cables, according to the plan, would be stretched between towers. The airplane "car" would run along the line of the cable, to which it would be connected, but not upon it.

From Steel Plates to Giants of the Rails



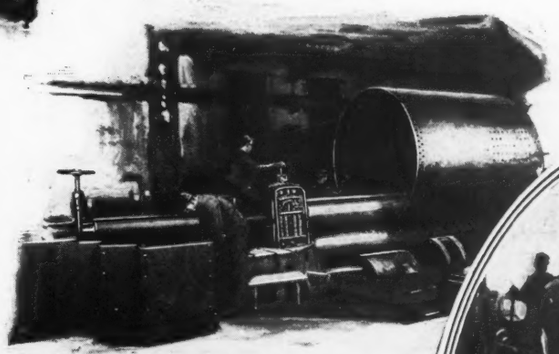
ALMOST READY FOR THE TRACK
As the Pacific (4-6-2) type locomotive nears completion, magnesia lagging is applied to the boiler and later covered with the metal boiler jacket. This lagging prevents excessive radiation by confining the heat to the surface and interior of the boiler

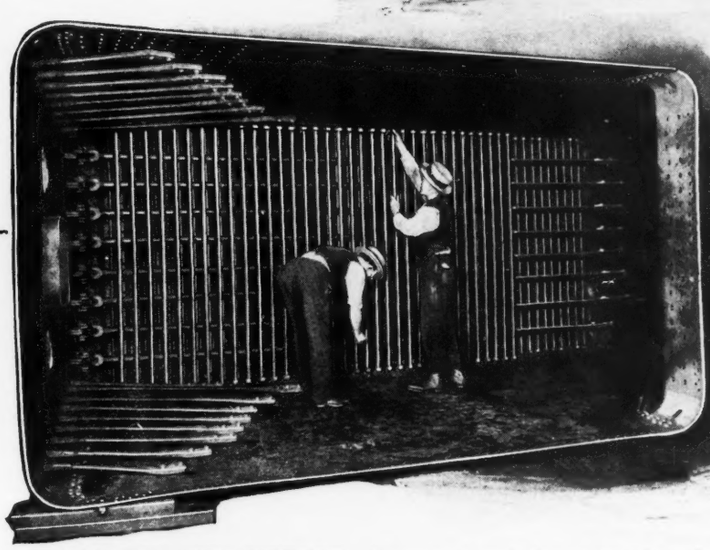


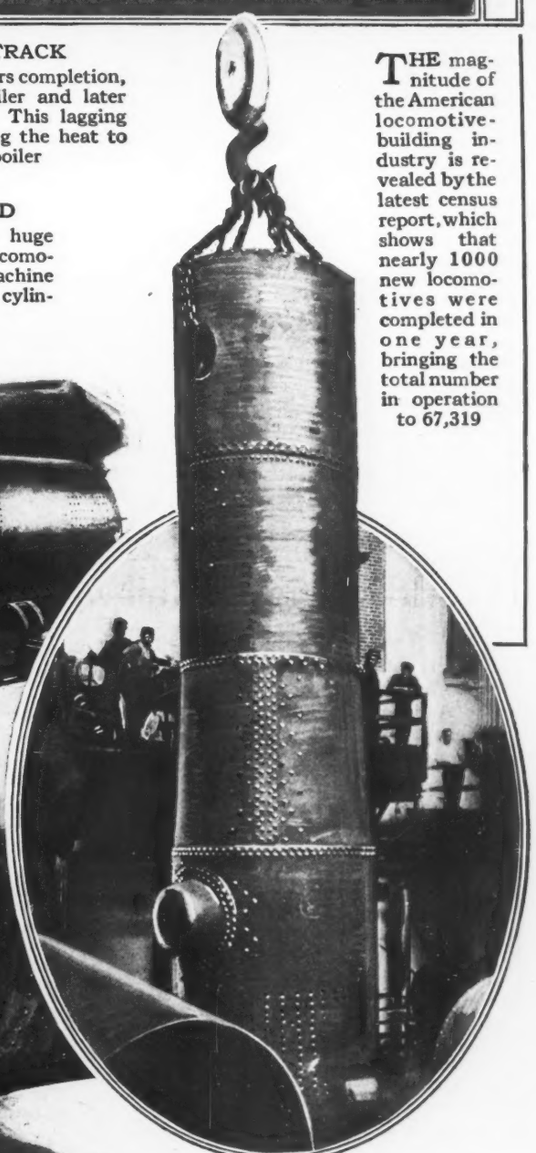
HOW BOILER IS SHAPED
Flat steel plates, curved into huge cylinders by rollers, form the locomotive boiler. Below is shown a machine bending one of the plates into a cylinder six feet in diameter

THE magnitude of the American locomotive-building industry is revealed by the latest census report, which shows that nearly 1000 new locomotives were completed in one year, bringing the total number in operation to 67,319

PROTECTING THE CYLINDER
To preserve the cylinder from wear and tear as the piston works back and forth, a lining or "bushing" is fitted inside. The bushing is forced into place by a powerful machine in the manner illustrated above







"NAILING" THE SECTIONS
While the boiler hangs in a vertical position, its cylindrical sections are fastened together by rivets forced into place by hydraulic riveting machines

BRACING THE FIREBOX—To prevent explosion of the boiler, the top of the firebox is braced by long rods that prevent undue expansion or contraction

Why Not Build Your Home of Cinders?

Coal cinders, mixed with cement and a chemical binder, are formed into bricks by the hand press shown above

Because of the large size of the bricks a wall can be constructed speedily in the manner illustrated at the left

CINDER bricks, from 30 to 35 per cent cheaper than ordinary brick or tile, are being used in the construction of a $100,000 house in New Rochelle, N. Y. These bricks, invented by Frank Cordery, of New York City, are made in a hand press on the spot from ordinary coal cinders, cement, and a special chemical binder.

Because of the large size, it is claimed they can be laid more quickly than other material. In addition, the porous cinders, strengthened by the cement, make a brick that is an excellent insulator of heat and cold and is soft enough when first turned out to allow plaster laths to be nailed direct to the inside surface.

In making the bricks, the cinders and cement are mixed together with a hoe or shovel in the same manner as a batch of mortar is prepared. A press squeezes out most of the moisture except such as is retained in chemical combination by the cement.

The bricks are kept in the press only for a few minutes.

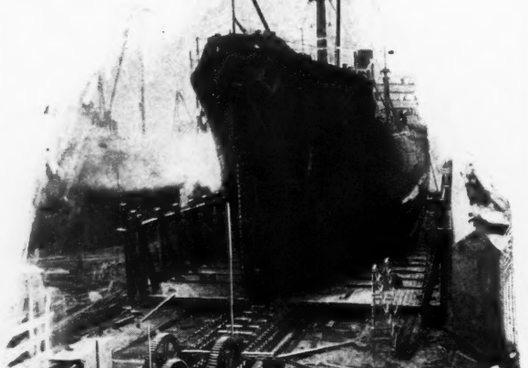
After this treatment they are allowed to dry for 24 hours before they are placed in the walls, although immediately after molding they are strong to handle and lay in piles. The same machine, using the same material, also turns out hollow block and tile for the interior walls of the house. Either a stucco or a smooth cement finish is used on the completed structure. The rough surface of the brick insures that this material will stick firmly to the walls.

World's Largest Railway Drydock Completed

THE largest railway drydock in the world, capable of handling ships up to 20,000 deadweight tons, was recently completed in a shipyard at Oakland, Calif.

The railway type of drydock still has no equal for speed and ease in docking. It consists of a heavy wooden cradle sliding on rails extending under water out into the bay. The ship is held in place facing the dock, and the cradle drawn beneath it until the keel of the boat rests on the keel blocks on the dock. Supporting blocks are then hauled beneath the bilges, and when these are in place a powerful winch hauls cradle and ship out of the water.

The new Oakland dock consists of a cradle 500 feet long and 76 feet wide. The winches are driven by a 500-horsepower slip-ring electric motor, with magnetic control. Three sets of spur gears transmit the power to the hoisting cables.

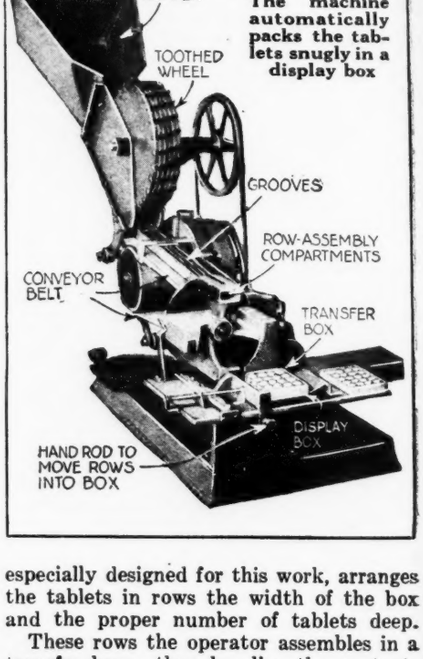


Driven by a 500-horsepower electric motor, the winches in the foreground haul cradle and ship

ONE of America's top-notch fortunes awaits the experimenter who first solves any of these current problems of chemistry: discovery of a new automobile fuel; of a way to utilize waste from burning of coal; of a profitable method of producing high-grade gasoline from oil shale.

Pills Slide in Rows from Hopper to Box

FLAT medicinal tablets are now packed into boxes in the most modern factories by a combination of automatic machinery and simple hand work. One machine,



The machine automatically packs the tablets snugly in a display box

especially designed for this work, arranges the tablets in rows the width of the box and the proper number of tablets deep.

These rows the operator assembles in a transfer box; then he slips the contents into the display box in which the goods are sold in the drug-stores. Eight or nine boxes are filled a minute.

The tablets are placed loose in the hopper, and pass by gravity under a toothed wheel, which is so arranged that only tablets lying flat pass through into the grooved channels of the raceway. Each groove is filled with an unbroken strip of tablets, edge touching edge.

Tablets Assembled in Rows

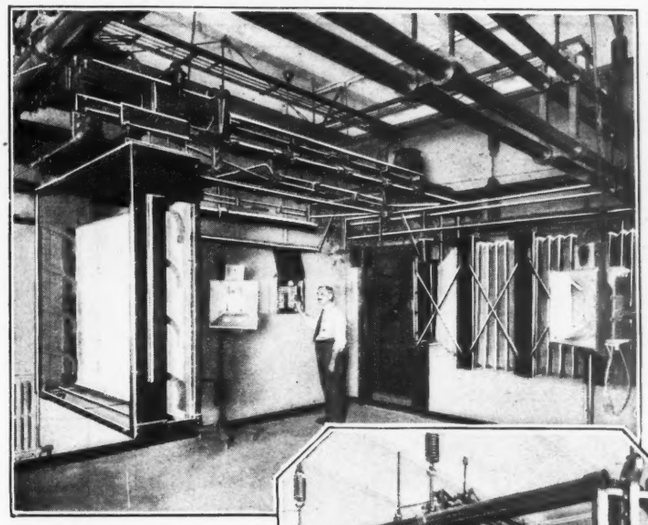
A moving conveyor-belt forms the bottom of the raceway, and this pushes the tablets into revolving row-assembly compartments. These are divided into as many sections, or shelves, as there are layers of tablets in the box when packed. In passing the end of the raceway, each shelf is filled with one row of tablets.

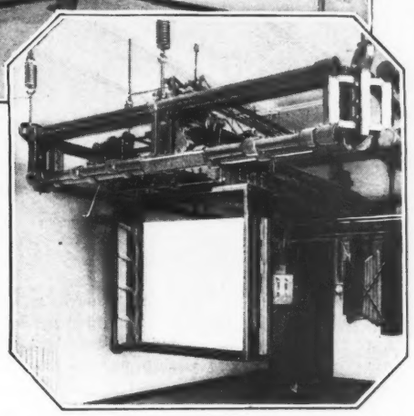
When the compartments reach the bottom of the machine, the operator pulls a hand lever that slides the contents of all shelves at once into a transfer box. One complete row of the proper depth goes in at a time. The transfer box is hinged and has a false bottom. As soon as it is full, it is moved to the right over a pasteboard or tin display box, the false bottom is pushed up, and the tablets are deposited.

Electric Motors Focus World's Largest Map Copying Camera

IMAGINE a camera that is as massive as a motor-truck, operated by electric motors, weighs 3½ tons, takes a picture one yard square and uses a stationary plateholder located inside a darkroom that serves as a camera box—and you will have a general idea of the largest camera in the world. This huge apparatus, of the prismatic type, is used by the United States Geological Survey to copy maps and tracings. It was invented by A. H. Linsenmeyer, chief photographer of the bureau.

The camera proper consists of a rubber bellows extending through the wall from a darkroom where the plate is held. Heavy iron framework comprising the focusing apparatus is hung from the ceiling by large shock-absorbing springs that eliminate all vibration. This framework consists of two connected carriages, moved over special tracks by electric motors. One carrier moves the lens, prism, and camera bellows; the other supports the copyholder, which is placed at right angles to the lens.



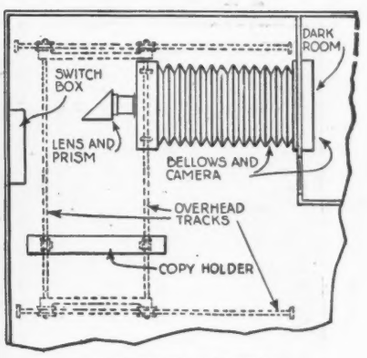


GETTING THE FOCUS

By turning switches the photographer moves the camera lens and the copyholder

RUNS ALONG TRACKS

How the focusing apparatus is suspended from tracks by shock-absorbing springs is shown at the right



HOW THE CAMERA WORKS

This diagram of the world's largest camera shows the position and movements of the various units

The tracing or map to be photographed is placed between two large glass plates 48 by 72 inches in size, and is centered by a system of automatic regulators. After the map tracing is in place, the photographer turns a switch that moves the sliding lens of the camera forward on its track until it arrives at the point of proper focus. There is a special scale along the track of the copyholder that similarly governs its movement.

As soon as the lens is in focus, an electric lamp is flashed automatically to inform the operator that he may turn on another switch that lowers the plate curtain, opens the lens, and exposes the negative. This switch is so adjusted that it also regulates the time of exposure. After the picture is taken, it is a simple matter to remove the plate and develop it expeditiously.

Machine Duplicates Master Engraver's Art

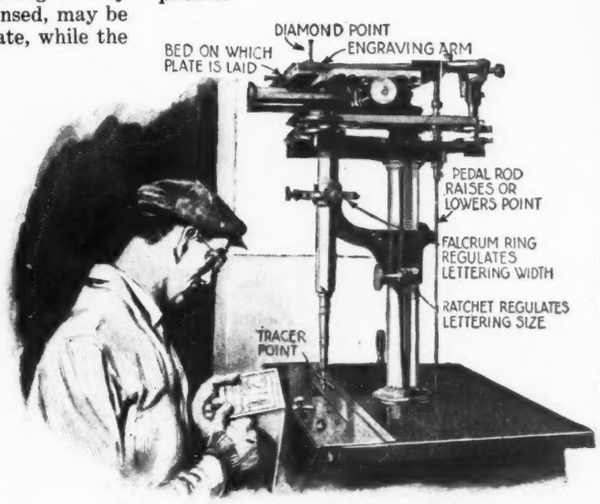
DELICATE lines and shading, the pride of the master engraver, are now being duplicated by engraving machines equipped with diamond points and operating on the principle of the pantograph to produce steel and copper plates for plate-printing and die-stamping.

Master plates, into which all the characters of the alphabet in each style of lettering are cut in intaglio, guide the pantograph. By changing the adjustments of the engraving machine, lettering of any size, either extended or condensed, may be engraved from one master plate, while the diamond point produces the fine-line effects, the delicate cross hatching and shading, which were the despair, and pride, of the master hand engraver.

In the preparation of steel or copper plate for the machine, the plate is cleaned and polished, then coated evenly with a "resist" ground that will protect the surface when the acid is applied. The master plate is then placed on the table of the engraving machine, which is adjusted to cut whatever the size of lettering desired.

The operator follows the letters of the master plate with a stylus, or tracing-point, while the diamond point on the engraving tool cuts through the "resist" coating into the metal of the plate until the entire lettering for the job has been traced out. The polished surface of the steel or copper is exposed, of course, wherever the diamond point has touched.

After a sealing-wax dam has been built around this lettering, an etching solution is poured on and allowed to stand until the acid has eaten into the metal. The "resist" is then washed off with turpentine; the plate is casehardened, then sent to the printer.



DIAMOND POINT COPIES MASTER PLATE

Movements of the tracer point on a master plate are perfectly duplicated by the diamond point of the engraving-tool

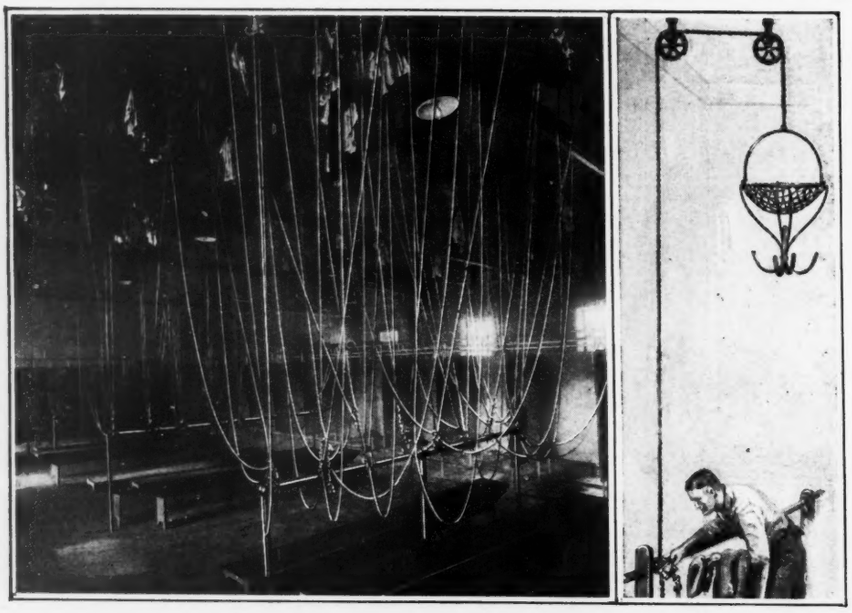
Phonograph in Log Adds Tone to Garden

JUST to add a rustic tone to his garden, M. W. Raihals, of Floodwood, Minn., has built a phonograph in a hollow tree-stump in such a way that he is not afraid to leave the instrument out in the rain.

The cabinet was hollowed from a cedar log three feet high, while a cover was scooped out with a chisel from the butt end of the same log. To make certain that the cover would remain watertight, the cavity was lined with an old rubber blanket.

The phonograph mechanism was assembled from two discarded motors and an old turntable, and the tone arm was improvised from a ¾-inch elbow and nipples of gas-pipe. A hollow log serves as the horn, making an excellent reproducer.

AS a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in POPULAR SCIENCE MONTHLY.



Hanger Lifts Workmen's Clothes to Ceiling

CLOTHES-HANGERS that hoist the mechanic's street clothes up to the ceiling of the factory rest-room, where sunlight and air have free access to them—and petty thieves have none—are said to be far more sanitary than the ordinary clothes-locker. The system, too, results in a saving in floor space.

This recent invention consists of a wire basket, with four clothes-hooks attached, which is hoisted by a chain. After hoisting his clothes, the workman locks the hanger by slipping a padlock through the links of the chain where it is wrapped around an iron bar running along the side of the room.

All parts of the hanger are heavily galvanized, as it is intended for use by shops where the worker's clothing is wet after a day's work, and must be dried before morning. The basket is attached to the chain in such a manner that it will hang level even if it has been loaded unevenly.

Handy Desk Pockets Keep Papers in Order

POCKETS, or filing shelves, have largely replaced the old fashioned desk drawer on a new form of typewriter desk especially designed to meet the stenographer's needs. Because everything is within easy reach, it is claimed she can do 25 per cent more work in a day.

Instead of dropping down out of sight, the desk top tilts backward and upward when the desk is open. On the under side are pockets for envelopes and the stationery forms most often used. Here, too, is an adjustable copyholder for stenographic notes, so that the typist need not glance to one side while copying letters.

Under the desk top are handy racks and a copy holder

Special receptacles—there are five individual compartments in the right hand top drawer—increase efficiency by preventing fumbling for articles usually tossed pell-mell into a drawer. Below each top drawer is a tilting compartment of the vertical file type.

Kiddies Draw Pictures Blindfold; Can You?

CAN you look at some simple object for ten minutes; then, after being blindfolded, copy the object accurately without seeing your pencil?

Kindergarten kiddies are doing just such a stunt these days as part of their education, accomplishing what the average "grown-up" would find hard to duplicate. The purpose is to train children's fingers, memories, and form sense independently, without relying wholly on the eyes.

A doll, toy animal, or some other comparatively simple figure is held up before a class for about 10 minutes, while the children examine it and try to fix its outline in their minds. Then they are blindfolded, and must copy the figure from memory.

© Keystone

After examining the toy for 10 minutes, the child sketches it from memory

Spring Acts as "Other Man" on Crosscut Saw

ONE man can operate a lumberman's double-handled crosscut saw by means of an attachment invented by Elias E. Hornstad, of Redfield, N. Dak. An adjustable clamp is secured to the trunk of the tree that is to be felled. This clamp holds one end of a heavy, flat spring. The other end is attached by a pivoted joint to the free end of the saw, from which the handle has been removed.

The spring functions in the place of another man to give a return push to the saw after it has been pulled through the cut by hand. The attachment is particularly intended for use in felling trees.

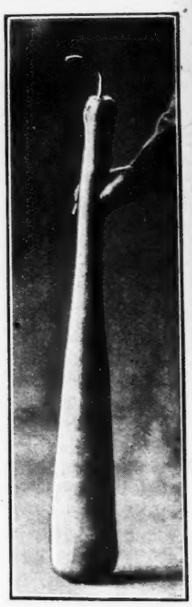
ARTIFICIAL camphor now made in quantity in the United States from coal-tar has broken Japan's long established world monopoly in the drug.

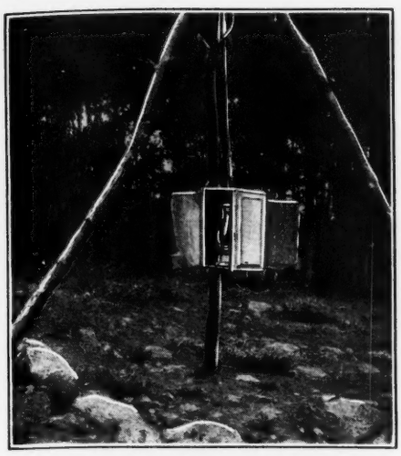
Here's a Man-Sized Ball Bat Grown in Garden

SECOND-GROWTH white ash is becoming scarce, but baseball players needn't worry. H. Cords of Elkader, Ia., can grow what seem to be perfectly good bats.

He planted a squash-vine last summer alongside a ditch, and as the vine grew across the ditch, one squash started to grow in midair. With nothing below for support, its weight pulled it downward as it grew until the end of the squash touched the bottom of the ditch. The vegetable then grew somewhat thicker near the lower end.

The shape of the squash at maturity was almost that of a baseball bat. At harvest time many of the strange vegetables were gathered from the ditch.





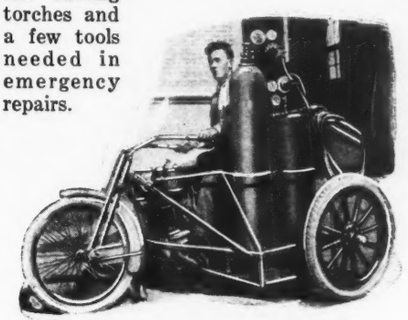
Swinging Reflectors Frighten Off Coyotes

A NEW device to frighten coyotes away from flocks of sheep consists of bright sheets of tin, hung around a lantern from a tripod erected in an open space near the flock. As the lantern and the reflectors swing to and fro in the wind, bright flashes of light penetrate the darkness all night long. Seeing these flashes, the coyote thinks a man is on watch, and is too shrewd to run the risk of approaching the sheep.

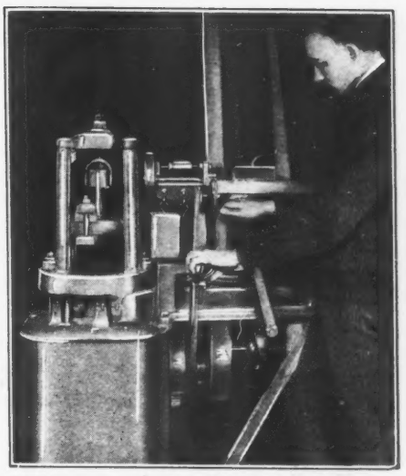
Emergency Welding-Kit Is Mounted on Motorcycle

OXYWELDS are made in a jiffy with a high-speed emergency kit designed by the emergency department of the New Orleans Light & Power Company, to solve the problem of evolving a means of conveyance that would be at once light, quick, efficient, and economical.

An old motorcycle was fitted with a third wheel from a light automobile. The tanks were mounted on a light frame supported by bands of strap iron. The triangular box over the third wheel carries the cutting torches and a few tools needed in emergency repairs.



An old motorcycle with an automobile wheel attached carried the welding outfit on a light frame



What Is the Nail-Holding Power of Wood?

READERS of POPULAR SCIENCE MONTHLY have probably realized what a fund of useful information is furnished by the United States Forest Products Laboratory. Almost every issue of the magazine bears witness to its valuable research work.

The machine shown here is one that is used by the laboratory to test the resistance to nails of various kinds of wood, in order to ascertain which wood is best suited for packing-boxes, etc., an economic item that will save much waste.

Comparative results are obtained by varying the spacing and size of the nails and the species, thickness, and moisture content of the wood.

Railroad Tickets Are Printed while You Wait

A COMBINED printer and recording machine for railroad tickets will make the lines move faster past the ticket-windows. The device takes no longer to make a ticket for a destination three thousand miles from the selling-point than for a local ride, even if the former ticket requires from six to eight separate coupons. An index wheel indicates the prices of the tickets, so that the passenger need not wait while the agent looks through a railroad rate-book to determine the charge.

The operator adjusts the machine for any station

The machine is a combination of a cash-register and a bookkeeping mechanism, with a special printer adapted to meet the conditions of the local office where it is in use.

When a passenger calls for a ticket, the operator sets the machine to the desired destination by means of the index wheel located at the right-hand end of the machine. These destinations are arranged in alphabetical order, and each group is designated by large letters.

The operator prints the ticket and records the transaction by pressing an electric button. In stations where electric current is not available, one turn of a small crank completes the operation.

The machine is equipped with two rolls of paper—a blank roll of safety or protection paper used for railroad tickets and a roll of plain white paper.

On the safety paper the machine prints the complete ticket, including the destination, number, date, and price, including the war tax. The date appears on the face of the ticket instead of on the back.

The record side of the machine does almost all of the bookkeeping required for the ticket sale. This report printed on the white paper is virtually self-audited. A positive connection between the ticket-printing side of the machine and the recording side sets down the complete distribution of the ticket charge to the various railroads over which the passenger is to travel.

At the close of the day's business, the ticket agent need not check up the tickets sold nor make a lengthy report. He merely tears off the record printed by the machine and mails it to the general auditor's office. This report covers every item in connection with the ticket sales.

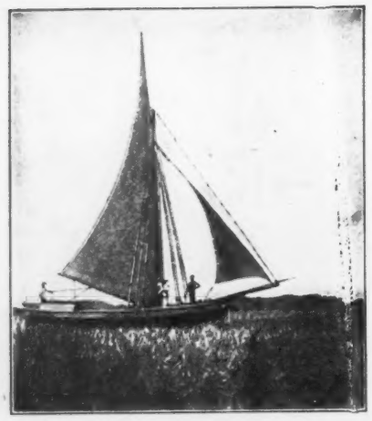
Arctic Cold Affects Battery

AT 100° below Centigrade zero the voltage of a storage battery commences to reverse and then to fluctuate between positive and negative as the low temperature affects the electrolyte. In other words, at temperatures below minus 100°C., a storage battery tends to charge itself. Unfortunately, the phenomenon cannot be commercialized, since the currents at this temperature are too small to be appreciable.

Rubber Tires Now Carry the Bass Drum in Parade

BASS-DRUMMERS used to need a strong back as well as a keen sense of rhythm, for it was a real man's job to carry a big drum throughout a five-mile parade. As the drums became bigger and bigger, small boys used to more than earn an honest quarter by holding up one end of the monster. Now comes the drum on wheels.

The drum-carrier being eliminated, the next step probably will be to abolish the drummer by attaching an automatic drumming mechanism to the carriage, in which the power would be supplied by a friction cone driven by the tires, and the tempo of the music governed by sliding the cone back and forth across the tire until the proper beat was secured.



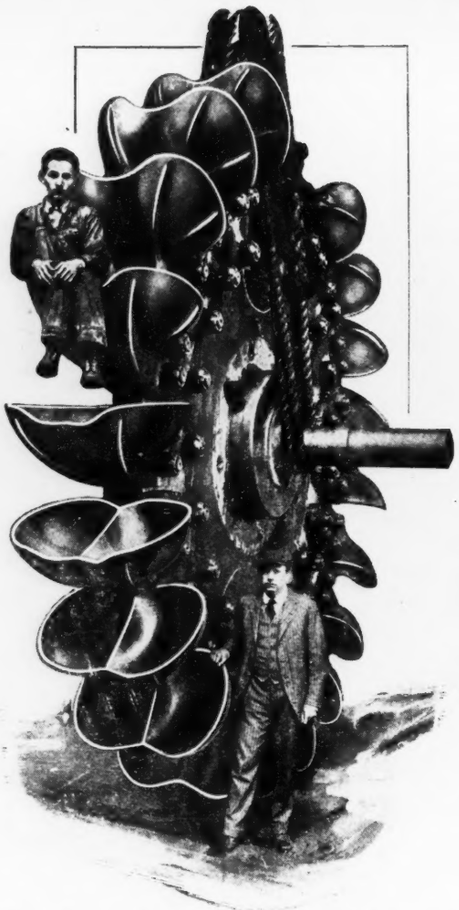
Through the Fields in a Sailboat

TO travel for miles through the meadows of a cattle country in a sailboat was the experience of Dr. William C. Farabee, of the University of Pennsylvania during a recent search for archeological specimens on the island of Marajó, at the mouth of the Amazon.

Although, in the photograph reproduced above, the boat appears to be traveling over dry land, from six to eight feet of water is under the keel.

Nowhere is Marajó more than 20 feet above sea level. During the summer the plains afford grazing ground for enormous herds of cattle, but in the rainy season, from January to June, the greater part of the island becomes a vast lake.

Since there were no roads, Dr. Farabee decided to get out his specimens by boat. He sailed his boat for miles, carrying a canoe for travel over the shallowest areas, and a pair of oxen to haul the canoe.



Huge Buckets Turn Largest Water Wheel

BUCKETS weighing 1000 pounds apiece, to withstand the impact of water that will drop 1008 feet, are the feature of the largest impulse water wheel ever constructed. The wheel, installed at the plant of the Great Western Power Company at Belden, Calif., is of the double overhead impulse type, developing 30,000 horsepower at 171 revolutions a minute.

Each turbine unit has two of these impulse wheels, mounted on opposite ends of the main turbine and generator shaft.

Burros Carry Ore on Snow Pathway

MINE operators in the Rockies, who depend upon pack animals for transporting ore to the market, must keep the burros going even during midwinter when trails are covered with six to ten feet of snow. Otherwise the mine would be compelled to close down for lack of room to store ore.

Instead of shoveling out the trail—which would drift full again in a few hours—a pathway of snow is built, and the animals are led over a solid-bedded trail six to ten feet above the earth's surface. Usually 10 to 15 burros are tied together in a "string," driven by one man.

To build such a trail, the rear burro, instead of carrying two or three sacks of ore on his back, drags one of the heavy sacks over the snow. Thus, as the snow falls and drifts into the trail, it is packed down by the moving sack till finally it becomes a solid, compressed mass of snow two to three feet wide and six to ten feet deep.

Air Propeller Drives Canal Barge

AIRPLANE propellers may soon be moving heavy freight along the barge canals of France as a result of recent experiments in which a barge 120 feet long was propelled down the river Seine by a 20-horsepower airplane motor at the rate of three miles an hour. The propeller was mounted at the stern of the barge.

The new method will find its chief use, it is expected, on streams too shallow for underwater propellers. Many such streams on which no freight can be transported at present, flow between French colonial towns in northern Africa.

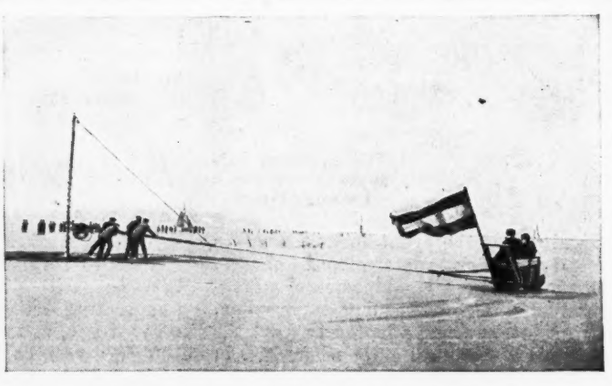
Driven by a 20-horsepower airplane motor, the air propeller moved this 120-foot barge three miles an hour

Merry-Go-Round Is New Ice Sport

SIXTY miles an hour in a merry-go-round! That's the newest homemade winter sport on the frozen waters of Holland.

To build a merry-go-round that will supply thrills of this sort, erect a mast on the ice in the center of a large open space, and to this attach a swinging boom. To the outer extremity of the boom, fasten a small sled by a wire rope 20 or 30 feet long.

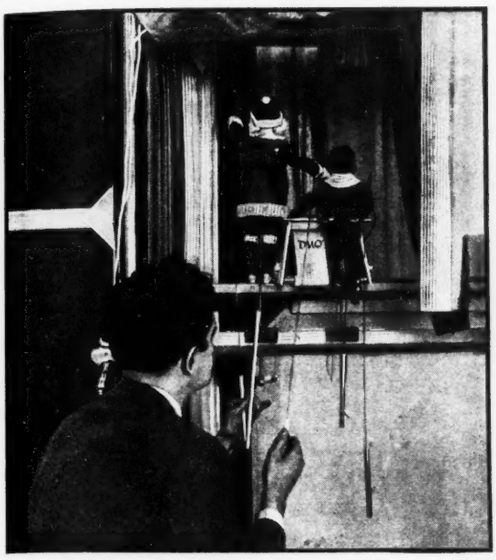
With two passengers in the car, and four men pushing the boom around the pole as fast as they can walk, the leverage is so great that the car sometimes travels at a speed estimated to be a mile a minute.



Four men, pushing a boom to which the sled is attached by a wire rope, provide a speedy ride over the ice

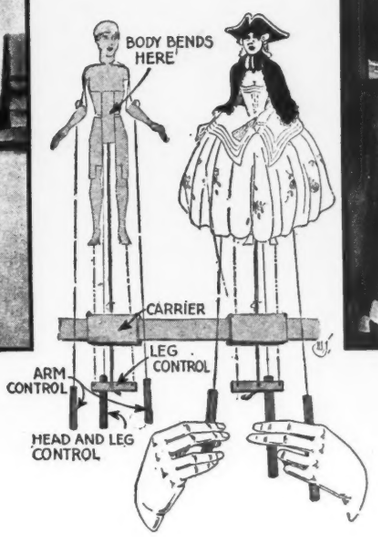
Your Own Show in Your Home—with Wooden Actors

Inventor's Simplified Puppets Revive Age-Old Amusement



The stage floor, seen here from "back stage," consists of rods along which the puppets slide

How the complicated movements of the puppet's arms, legs, and head are controlled by only three wires is illustrated below



In this cut-away view the "producer" is seen pulling the draw-strings of the curtain

YOU can have your own theater in your home. You can be your own playwright, actor, and producer, successfully staging the world's greatest dramas!

All this is possible today because modern inventive skill has invaded a field of drama almost as old as man, and has transformed the clumsy puppet of the past into a skilful, gesticulating actor that even a child can operate.

Just as the talking machine and the radiophone have brought music and entertainment into the home, so the very latest marionette theater is bringing drama to the fireside, the school, and the community center.

The success of the recently patented puppet show is due to the fact that the marionettes are operated by wires from below the stage, instead of by strings from above, and that the complicated actions of each puppet are controlled by only three wires. In the past, as many as 30 strings have been required to manipulate a puppet, and this demanded a great amount of skill. The new mannikins will not only walk, stoop, rise, sit, jump, and gesticulate with hands and head, but will even climb out of windows and walk through doors, and disport themselves in other ways—performances impossible for puppets suspended by strings.

Mathurin M. Dondo, inventor of the new marionettes at the right, demonstrating their versatility

The simplified marionettes depend largely upon a cleverly arranged stage. Instead of a stage floor are horizontal steel rods on which the puppets slide. They are held by wires and operated from below.

The figures are carved from wood and are from 15 to 20 inches high. Each is mounted on a thin wire attached on a pivot to a ball-bearing sliding sleeve that travels along the steel rod, so that the figure can turn around on the stage and enter and exit.

The three controls are also made of fine, stiff wires, one leading to the head, which is kept in almost continuous motion to imitate the movements of speech, the two others attached to the elbows, controlling the arms. A pivoted lever under the sliding base, with wires leading to the feet, controls the movements of the legs for running, walking, and jumping. This can be operated by one finger without releasing any of the other controls.

By the use of wires instead of strings, the mannikins will retain any position given to them. This is an enormous aid in manipulating two or more puppets at once, for after placing one of the little wooden actors, the operator can use both hands to manipulate the other two, keeping the head of the third figure moving by pressure from the little finger to prevent this character from seeming lifeless.

The improved marionette is the invention of Mathurin M. Dondo, professor of Romance languages in Columbia University, and was perfected to carry out his idea of using the puppet show as a means of making the ancient drama of France vivid and real to his classes.

Make Your Puppets and Stage a Show

MANY readers of this article will want to make a set of puppets in order to stage shows at home for the amusement of friends or children.

On page 88 of the Home Workshop there are complete, detailed instructions for making puppets of the type used by the famous Tony Sarg.

Gooseneck Boom Aids Work in Lumber Yards

This boom is useful in handling lumber from high piles

LUMBER YARDS are adopting gooseneck booms because, in handling lumber from high piles, long boards often foul the straight boom and slow up the job. The specially braced gooseneck type may be raised almost straight up without any interference from the load.

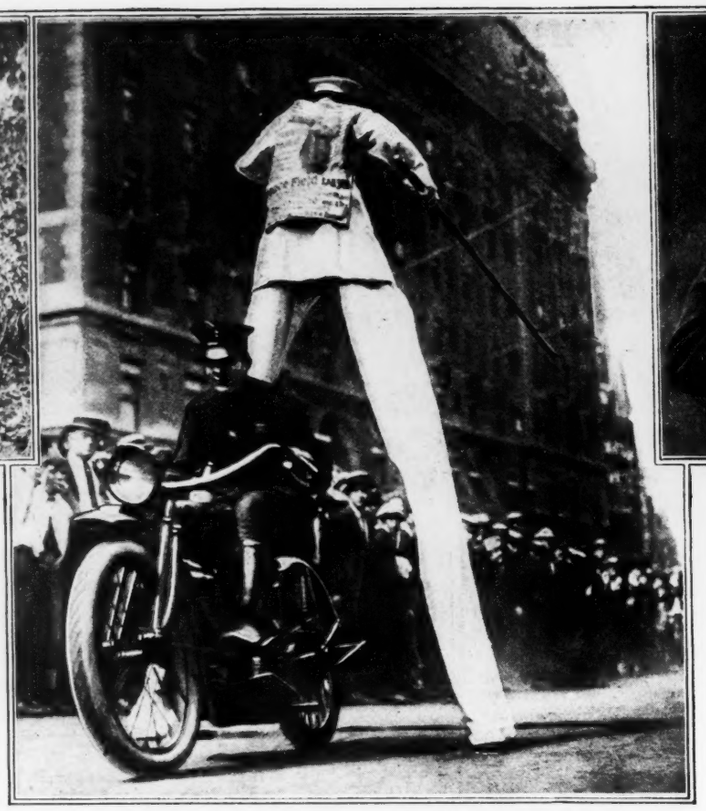
Furniture factories were the first to adopt this equipment. Their lumber was taken from the top of twenty-foot piles from aisle-ways eighteen feet wide, and placed on trailers behind the crane. Hard wood weighing four pounds to the board foot was handled at the rate of fifteen hundred feet a crane load.

How to Carry a Live 'Gator

IT'S perfectly easy to carry a ten foot alligator on your back, even if it is alive—if you know the proper system. A slip noose about the throat and a half hitch around the jaws keep the brute from biting.

However, the front end of the reptile is not the most dangerous, say the professional 'gator hunters. For the alligator fights best with his tail. A comparatively short blow with this extremity carries power enough to knock down the strongest man. Therefore, hunters who know, double back the end of the tail in tying up the 'gator.

This paralyses the nerves of the tail.



Would You Like to Step Over Traffic?

THERE still remains one safe and sure way to cross the streets of New York City through the traffic—by walking on stilts! This was demonstrated recently on Broadway by Fred. H. Wilson, of high-stilt fame.

Looking down on the crowds from a 15-foot altitude, Wilson spread his beanpole legs just in time for a motorcycle cop to speed under the human arch at 45 miles an hour.

Wilson is naturally an unusually tall man; and when he straps eight-foot stilts to his legs, there's no trouble picking him from a crowd. A long cane that he carries isn't long enough to reach the ground; he uses it merely as a balancing-pole.

In the course of his strolls through the streets, the "stilt man" is the envy of small boys who take a supreme delight in scampering between his shins.

Largest Coin Ten Inches Square

HOW would you like to carry a pocketbook full of coins, each weighing 6½ pounds, and each measuring 10½ inches square and 3/16 inch thick? To carry enough of this money to buy a suit of clothes, you'd probably need a wheelbarrow for a purse.

The world's largest coin, said to have been turned out by Sweden, is in the possession of Farren Zerde, famed internationally as a numismatist, who has spent 40 years in acquiring a collection of 30,000 rare coins valued at more than $50,000,000. He says the value of the world's largest coin is approximately four dollars at present exchange rates.

Cows Live in a Palace

COWS lead luxurious lives in Vincent Astor's dairy, maintained in connection with his country home near New York City, where all the latest devices for the comfort of the cattle and absolute cleanliness of the milk are in use.

The Jersey thoroughbreds eat and drink out of porcelain-lined troughs that are flushed with water after every meal until they are as clean as dinner plates. The walls, ceiling, and floor are covered with glazed tiles that can be washed frequently.

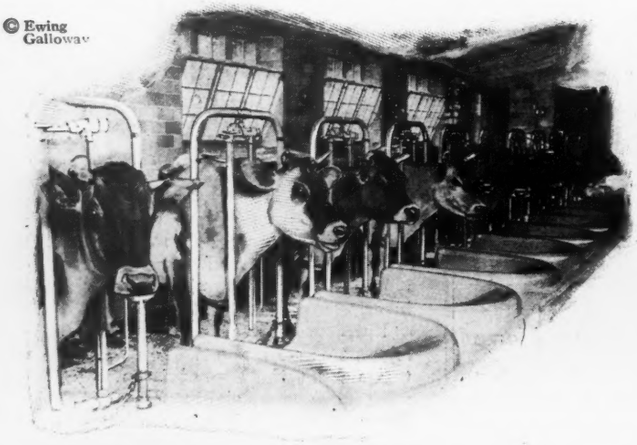
The barn is electrically lighted and heated in a way that is said to increase materially the yield of milk.

WOLVES are rapidly growing extinct in the United States. The Biological Survey estimates there are now less than 500 remaining, and this number is being rapidly reduced by the government's professional hunters.

Bet Makes Him Nursemaid

WHEN Mrs. Tom Wintringham was elected to the British Parliament, a silk-hatted, spatted man, who naturally refused to give his name, started down the Strand, London, pushing a perambulator and leading a highly indignant lamb on a string. The immaculate clothes, silk topper, and spats were all the outcome of an election bet.

After amusing the London crowds in the course of his one mile stroll, the stranger disappeared in a taxicab. He intimated that in the future he will be more careful how he bets against a woman winning a seat in the House of Commons.

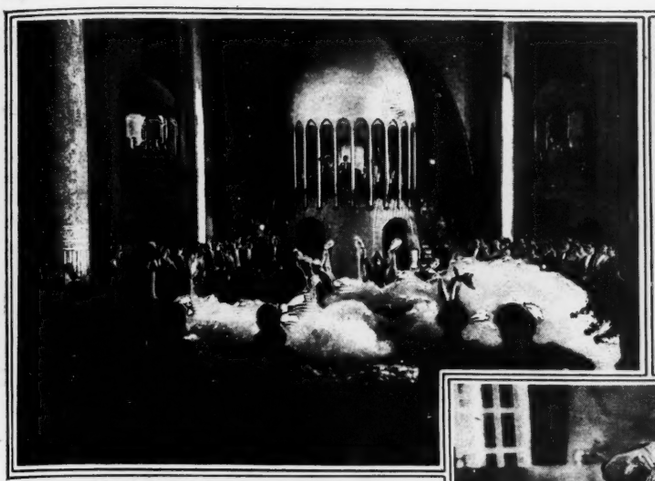


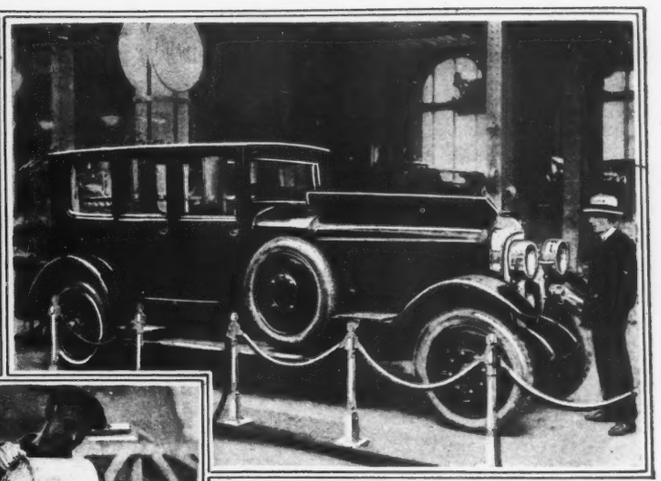
© Ewing Galloway

Porcelain bowls, washed after each meal, are among the luxuries enjoyed by these Jersey thoroughbreds

©K. & H.

Wheeling the perambulator wasn't so bad, but the lamb objected vigorously to being pulled along the Strand by a leash





Workmen outside the studio poured barrels of lather into the bubble tank

"Movie" Dancers Sport in Sea of Soap Bubbles

SOAP bubbles blown through holes in the floor recently transformed a ballroom into a sea beach with a group of classic dancers sporting in the foam.

The bubbling sea was in the "movies," of course. A tank placed beneath the stage and filled with lather and compressed air did the business.

In producing the effect, the first step was to punch fine holes in the top of the tank, which served as the center of the stage, until it resembled a great kitchen colander. Next, by means of a pipe and funnel, workmen outside the studio poured several barrels of lather into the tank.

When rehearsals had been completed and the cameramen were ready to "shoot" the scene, a compressed-air machine forced air into the tank, through the lather, and out through the perforated top. The air and lather, passing through the small holes formed soap bubbles like those produced by any child with a bubble pipe. The bubbles rose about four feet high, and endured nearly half an hour.

Limousine Larger than Five-Ton Truck

IS there no limit to the size of autos? A Spanish limousine exhibited at the Automobile Show in Paris is larger than a five-ton truck. A special step is attached to the hood in order that the chauffeur may be able to reach the radiator, for the top of the hood is about five feet above the ground.

The chassis, springs, tires, and wheels are as large and heavy as those of a truck. The suspension, however, is well designed and the car is reported to have excellent riding qualities.

From an engineering standpoint there seems to be no limit to the size of cars except the width of the average street; but with increasing weight the expense of car and tires mount out of all proportion to enlarged carrying capacity, so that monsters like this are likely to be more popular in the exhibition room than on the road.

Make It the Best Trip Yet!

WARM sunshine, spring in the air, and the open road ahead!

Right now, you are making your plans for the summer's gipsy motor tour—plans that you began to form vaguely even before last summer's trip was ended.

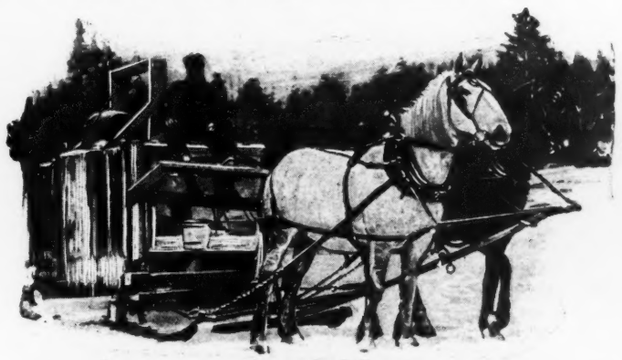
Before you complete your equipment, be sure to read the June number of POPULAR SCIENCE MONTHLY—an issue that will be brim full of new ideas and suggestions for every gipsy motorist.

THE head of a common shark is full of glue of highly valuable commercial quality.

Sprinkler Ices Logging Roads

THE water-cart is an important piece of equipment in Eastern lumber-camps, for where the West often uses aerial tramways for hauling logs, the East continues to rely upon logging roads made icy smooth by sprinkling.

Every night a two-horse bobsled carrying a rough wooden tank, the rear of which is full of small holes, drives over the roads by which the logs are hauled to the streams that float them to the sawmills. The water coats the roads with a thin layer of ice over which horses haul the logs with little effort.



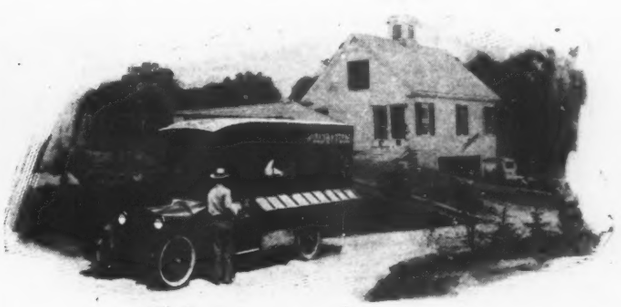
Every night in icy weather a two-horse bobsled equipped with sprinkling tank wets down the roads until they are smooth as glass

Rolling Hen Coop Is Hotel, Too

A TRAVELING hotel, a poultry farm, and a salesman's sample case all in one. Such is the capacity of an ingeniously arranged motor-truck devised by a grain salesman.

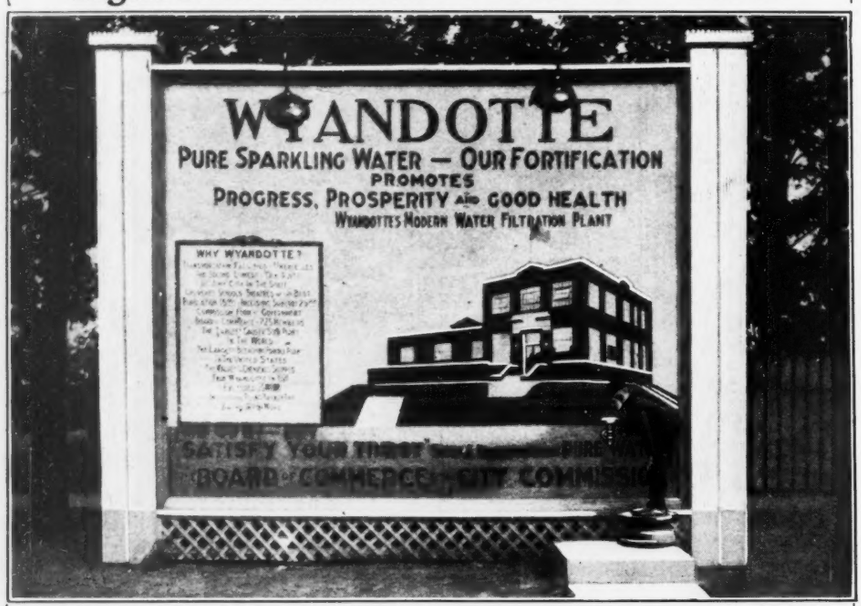
In the rear of the truck are sleeping quarters for two men. In front, in a glass-enclosed partition, travel 12 thoroughbred White Leghorn hens, whose excellent condition is an advertisement of the poultry feed on sale. These feeds, incidentally, are displayed in glass compartments along the sides.

The proprietor of this truck drives into the farmer's yard and lets him see what can be done by scientific poultry feeding.



A dozen fat, thoroughbred hens, traveling in the front compartment, advertise poultry feed. The salesmen who sells the feed sleeps at night in the rear

Signboard Fountain Advertises Town



GETTING a drink from a signboard is an everyday occurrence in Wyandotte, Mich. To advertise the town, and more particularly the sparkling water of which the residents are proud, a small drinking fountain has been placed on a large roadside signboard that calls attention to the town's advantages.

Care has been taken to bury the pipes deep in the earth, with the result that the water is cool the year round for the refreshment of visiting tourists.

Phone Mouthpiece Permits Quiet Conversation

ANY telephone is as private as a sound-proof booth when a new sound-absorbing mouthpiece is attached, preventing the voice of the speaker from being overheard by persons working near by. In addition the attachment prevents office noises from making the voice on the wire inaudible.

The mouthpiece encloses the lips

It is claimed that the new invention, perfected by L. S. Scher, of New York City, will absorb all sound waves not essential to transmission, and keep outside noises off the wire.

The invention consists of a curved soundbox large enough to allow the sound waves to expand slightly, a mouthpiece that encloses the speaker's lips and keeps them close to the transmitter, and two sound-wave absorption units, renewable and antiseptic, placed at the ends of the device. Flared inner walls convey the excess sound waves to the absorption units.

With this instrument it is possible to speak into a telephone in an ordinary voice, without those near by hearing a word. No change need be made in the telephone instrument, as the sound-absorber simply slips over the mouthpiece.

Auto Wheels and Floors from Cotton Stalks

WASTE cotton stalks, the disposal of which is a problem on nearly every Southern plantation, may soon become the raw material for the manufacture of flooring, wood blocks, tile, and furniture.

A process of macerating, pulping, and compressing the fibrous stalks, it is claimed, will produce an artificial wood resembling papier-mâché in appearance and possessing sufficient tensile strength even for disk wheels of automobiles.

By varying the process and the pressure at which the pulp is compacted, the artificial wood can be made either hard or soft. It is also claimed that the product is not affected by weather conditions, and that it is almost uninflammable—qualities that make it particularly adaptable to high grade plaster board and roofing.

With cotton stalks thus turned into value, every part of the cotton plant except the root is utilized. Cotton seeds once were considered waste, but now they yield a revenue exceeding $150,000,000 annually in the form of cottonseed oil and cattle feed.

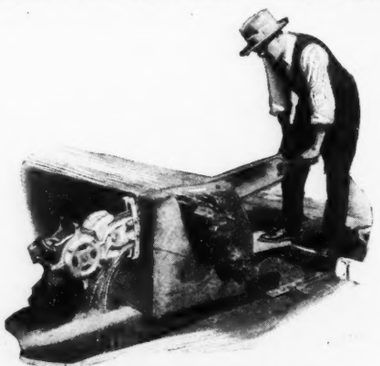
Electric Linksaw Does the Work of Ten Men

CUTTING 2½ square feet of lumber a minute, a new electrically driven linksaw that weighs less than 70 pounds and is operated on 1½ kilowatts an hour, will do as much heavy crosscut sawing as 10 men can do by hand.

The saw may be operated in any position, so that it can be used to fell trees, shape heavy construction timbers, or to take the tops off piling.

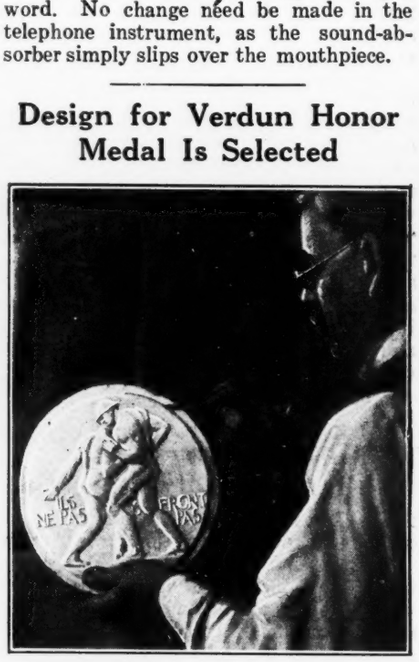
The saw links are of improved design. All the wear in the joints between the raker and the cutter is confined to a hardened steel bushing turning in the hole in the raker link. There is no wear on the pin, and therefore no decrease in strength. The teeth are balanced to prevent the saw from buckling, and to make it act in the cut like a rigid saw.

In operation, there is no back and forth motion. The teeth rotate entirely around the frame. Lubrication is accomplished by small felt inserts in the links. These carry enough oil for a day's work, and are protected from dust by the overhanging ends on the cutter links.



How the saw operates in shaping a heavy construction timber

Design for Verdun Honor Medal Is Selected



A SCULPTOR of Newark, N. J.—John Flanagan—has won the competition for design of the gold medal to be presented by President Harding, on behalf of the American people, to the city of Verdun in commemoration of the city's heroic defense.

The obverse side of the medal represents the struggle of two Titans, and the motto, "They shall not pass!" On the reverse appears the famous *porte chaussée* of the Verdun Citadel, with the view of the ruined city in the background. Here will be the inscription from the donors of the gift.

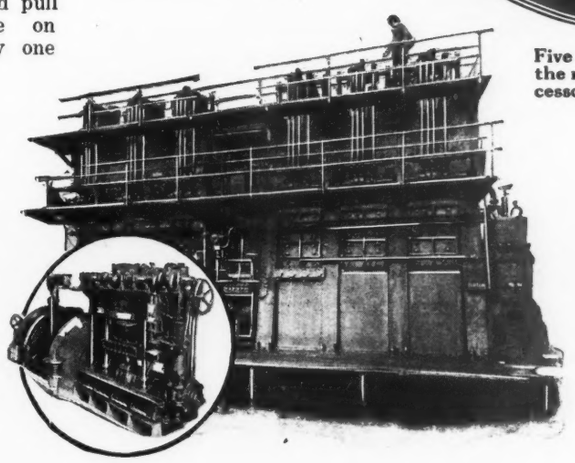
The medal was cast in pure gold at the Philadelphia mint, from the artist's plaster cast. The original sketch is four inches in diameter. Eight sculptors entered the competition.

"Impossible" Midget Engine Has Giant Power

How Revolutionary Diesel Invention Saves Cargo Space and Fuel

"IT can't be done," the greatest experts said. But Elmer A. Sperry, engineer and inventor, did it. Read in this article how, after 30 years of experiment, he has perfected a compound Diesel engine that seems destined to push our idle ships out of quiet harbors into busy seas.

Below (insert) a compound Diesel engine and a standard Diesel of the same horsepower are pictured to the same scale. The compound engine occupies less than one quarter of the space



Five pounds per horsepower will be the remarkable rating of the tiny successor to the present-day Diesel engine

SHIPS that idly swing at anchor in our harbors—what are they waiting for?

Cheaper motive power and greater cargo space—two important factors that would raise the anchors of hundreds of American vessels, turning losses into profits—now seem assured with the perfection of the "impossible," a compound Diesel engine.

Suppose some expert breeder should develop a superhorse—one that would pull harder than the average horse on the same amount of fodder, occupy one quarter of the stall space in the barn, eat cheaper food, and weigh only one tenth as many pounds. Wouldn't that horse fatten any farmer's pocketbook?

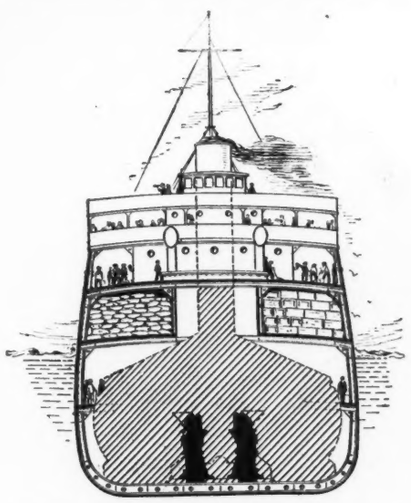
More Power in Less Space

Well, that's just what Elmer A. Sperry, famous inventor and engineer, has done—not with horses for the farm, but with Diesel engines for ships at sea.

"Compound a Diesel engine? It's mechanically impossible." So say all the textbooks. So said a group of engineers in 1900, while reporting that "if the combustion engine could be successfully compounded a most important gain would be made in reducing its weight and size." Diesel himself tried to compound his engine, and failed completely.

But Sperry was one engineer who refused to admit that it "couldn't be done."

For more than 30 years he studied and experimented with compounded Diesels. His first patent was granted in 1892; and now he has succeeded at last in perfecting a compound Diesel-type engine that may revolutionize prime movers throughout the world, and that is almost certain to be adopted universally for vessels.



Cargo space occupied by a reciprocating steam plant is indicated by the shaded area. Compare this with the small black space filled by a compound Diesel plant of the same power

By solving two problems, each believed to be insuperable, Sperry has perfected an engine less than one tenth, and, in special instances, less than one twentieth the weight of an ordinary Diesel of the same power, occupying less than a quarter of the space. It will burn any kind of crude oil, while the Diesel requires a special, partially refined "Diesel" oil, which is far more expensive and cannot be obtained at all in out-of-the way seaports.

To state these facts in another way: by installing one of the compound engines, it is claimed that a standard tank steamer would increase her annual earnings about $340,000—or more than the cost of one of the new engines—by the saving effected through increased cargo space and reduction in fuel consumption.

A reduction in the weight of shaft horsepower from 450 pounds to less than 40 make it seem almost certain that compound engines will come into universal use at sea; but even more far-reaching uses may be expected. Models now under construction will weigh less than five pounds a horsepower. This is close to the weight of airplane engines, and it may be that the compound Diesel soon can be used in aviation, assuring an increase of cruising radius and speed, as well as the total elimination of fire risk and the danger of accident from engine failures.

The secret of Sperry's success is the invention of a valve that will handle red-hot gases for months at a stretch without jamming. Its great efficiency is due largely to the fact that it eliminates some of the disadvantages of the Diesel engine.

In the ordinary Diesel cycle, air alone is drawn into the cylinder on the charging stroke. As the piston rises, this is compressed to over 400 pounds a square inch, which raises the temperature of the air so that it ignites the oil injected into the cylinder with a small amount of even more highly compressed air at the top of the stroke. There is no spark, and the power is obtained without an explosion in the cylinder—the mixture burns very rapidly, and the cylinder pressures do not rise above those of the compressed and injected air.

Defects that Sperry Remedied

To compress the air injected with the oil consumes about 10 per cent of the total power, and the three-stage compressor pumps often get out of order.

Again, the great weight of the Diesel is due to the fact that it is designed on the basis of an extremely small quantity of air or oxygen to be fired at each stroke. Less than 5 per cent of the cylinder volume—a mere crevice at the top—is actually occupied by an inflammable mixture. Yet the whole cylinder must be strong enough to withstand the extreme pressure of firing, although during 95 per cent of the cycle the actual working pressures are comparatively low and should be utilized in a low-pressure cylinder.

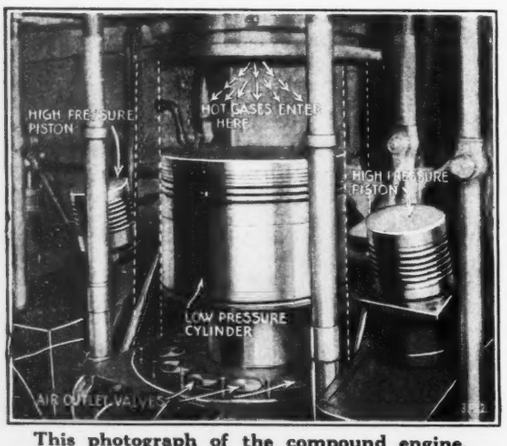
But in the compound engine there are

separate cylinders for the high and low pressure areas of the expanding gas. By introducing supercharging, or two-stage compression, large working volumes are secured in the cylinders, while the need of injection air and complicated three-stage compressor pumps is avoided. As a result the clearance space, or working volume of gas, may be nearly five times that of the ordinary Diesel, and yet it is easy to bring this enlarged volume up to the requisite pressure and incandescent temperature at the instant of fuel injection.

The Source of Power

Bear in mind that there are two high-pressure cylinders—each four-cycle—delivering power on every other stroke, and one low-pressure cylinder—which is two-cycle—delivering power on every stroke. As the low-pressure piston is impelled downward, it compresses a volume of air trapped on its under side. When this air is compressed to about 100 pounds a square inch, a by-pass opens and it rushes into the first high-pressure cylinder, which is starting its charging or compression stroke. By charging with compressed air, the amount of air inside the cylinder has been greatly increased, so that when the high-pressure piston rises, exactly as in the standard Diesel engine, and compresses the charge to 400 pounds a square inch, 25 per cent instead of 5 per cent of the cylinder volume is occupied by the incandescent air. Compression starts from 100 pounds, instead of from zero.

With this large clearance volume there is no difficulty in igniting solid injections of heavy oils. Indeed, the oil is burned almost instantaneously and explodes practically like the charge of a gasoline engine. Thus the gas pressure in the high-pressure cylinder of a compound engine does rise above that of the compressed charge, giving a gain in power at the very start of the stroke.



This photograph of the compound engine, with cylinders removed to expose the pistons, was taken after about 1000 hours' run on this remarkable engine

The entire high-pressure piston displacement causes the gas to lose only a fraction of its pressure. It comes to the low-pressure stage with sufficient volume and power to drive the low-pressure piston—which is 10 times the area of the high pressure—to the end of its stroke with gas pressures still above the atmosphere. The mechanical advantage gained by giving the gases this enlarged piston area to work upon is obvious.

Here, however, comes the great difficulty. The gases must be transferred from one cylinder to another while they are very hot. If they were allowed to rush into the low-pressure cylinder, they would quickly wear out the valve, and the drop in pressure would destroy all the gain of compounding. The low-pressure exhaust valve is therefore closed slightly before the bottom of the stroke, and a small amount of gas is trapped in the upper part of the cylinder, which is again compressed on the upstroke so that when the transfer valve is opened, equal pressures exist on both sides.

Solving the Crucial Problem

Even so, the temperature is so high that the valves would become white hot if they were not constantly being cooled by the compressed air passing to the high-pressure cylinder. Placing these two pipes one over the other, with a valve extending from one into the other, solves the crucial problem of compounding. The pressed air, owing to its density, has seven times the cooling power of ordinary air. The valve is heated on its under surface, and instantly cooled on a surface five times as great, so that it strikes a heat balance far below red heat.

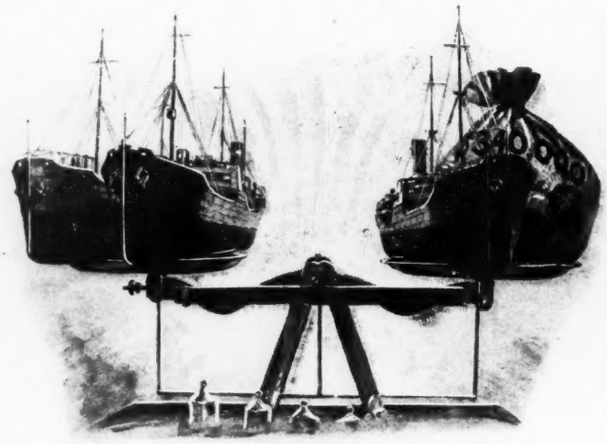
The great efficiency of the compound is due to the fact that the pressures persist throughout the stroke. Though only slightly higher than those of ordinary Diesels, the pressures are in larger quantity, and useful work is obtained while the gases expand from about 500 pounds a square inch clear down to atmosphere.

Expansion Ratio Increased

In this way the expansion ratio, instead of being 3 or 4 to 1, as in the automobile engine, or about 12 to 1, as in the Diesel, rises as high as 120 to 1 in the compound, and works through 315, instead of 120, degrees of crankshaft revolution. In other words, the power curve is 3⅛ times as long.

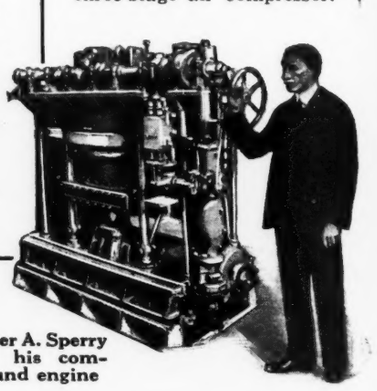
More remarkable is the fact that the inventions which have produced this increased efficiency after years of experiment have, at the same time, greatly simplified the mechanism of the engine and entirely eliminated the troublesome three-stage air compressor.

Every Ship a Profit Maker!



THE day when the seas will be spotted with busy American merchantmen, carrying vastly increased cargoes and operated at greatly reduced fuel costs, is nearer at hand because of the persistency of one American, Elmer A. Sperry.

Equipped with one of his compound Diesel engines, he firmly believes, a standard tank ship will be able to increase her annual earnings more than $340,000 and to equal the combined yearly earnings of two steamers of the same tonnage.



Elmer A. Sperry and his compound engine

Squirrel Does a Dance on Phonograph Record

A GRAY squirrel owned by Miss Manilla Martan, of New York City, is so fond of "jazz" dance music that he has learned to start a phonograph by putting his paw against the starting lever and pushing until the record turns.

When the disk has gathered speed, the squirrel jumps upon it and races against it as if in a squirrel

© K. & H.

cage. Trained to do many tricks, the animal originated this one without any instruction.

Squirrels particularly enjoy treadmill devices that turn under their feet as they race interminably upon them.

You Can Buy Gum on Street-Car

ALL the street-cars in Little Rock, Ark., are equipped with gum-vending machines fastened to the pilasters between the windows. Each machine weighs only three pounds and is built of steel. It is 3½ inches in width, 9½ inches in length and about 1¾ inches in depth.

It is especially designed to lock against the depositing of a coin if no gum remains in the machine, as well as against the insertion of a blank or slug.

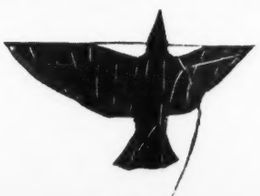
From the records of a year of gum-vending service, the railway officials have discovered that approximately four per cent of the passengers purchase gum.

Bird-Kites Aid Gliding

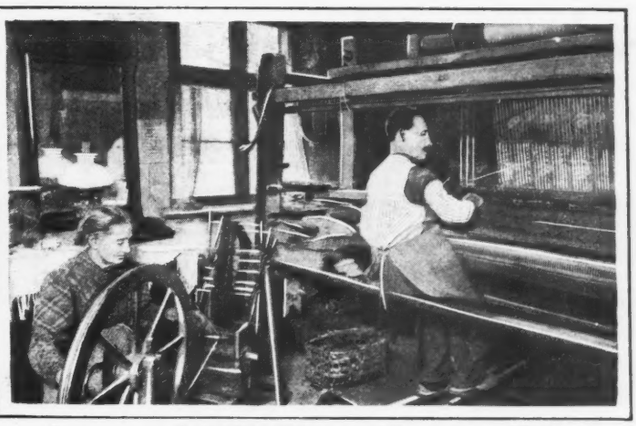
AVIATION enthusiasts, in their work of developing the motorless soaring machine, which POPULAR SCIENCE MONTHLY has featured in the February and March issues, are now experimenting with large, strangely formed kites to determine the best gliding angle, as well as the most effective arrangement of planes, for engineless gliders that have already given remarkable performances of coasting in the air.

The kites are sent up to a height of about 200 feet and then released. A series of observations with a theodolite reveal the gliding ratio of the kite. Sometimes moving-pictures are taken of the descent. These pictures then can be studied at leisure to enable the experimenter to correct the faults in his model.

The experimental kite shown in the photograph below is one of the Horstenke models, which closely imitate the form of birds. The usual glider, including the record-breaking model in which Klemperer made a flight of more than six miles, is more along the lines of the motor-driven airplane.



This kite, shaped like a bird, is one of those flown by experimenters in perfecting soaring machines



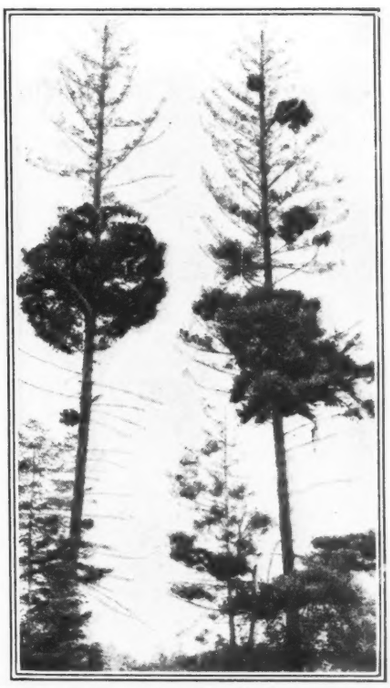
Looms of 1770 Weave Famous Fabric

USING methods and looms unchanged since 1770, a colony of German weavers established by Frederick the Great still continues to make yarn on spinning-wheels and weave textiles by hand, in spite of the machine industry that has grown up and flourished around them.

Descendants of the weavers who migrated to the town of Nowawes, near Potsdam, 150 years ago, have never changed their original methods. The excellence of their handiwork has enabled them to survive in spite of the competition with power looms.

One worker, known as the oldest weaver in the colony, is shown in the photograph above at work at his loom. At the age of 81, aided by his aged wife, he still turns out the durable, smoothly woven fabrics for which Nowawes has been famous throughout Europe for more than a century.

Mistletoe Ruins Timber



DO you know that the mistletoe you hang over your doorways at Christmas-time is a parasite that destroys valuable trees in our forests? In recent years it has become such a menace as to cause the Forest Service to take drastic action.

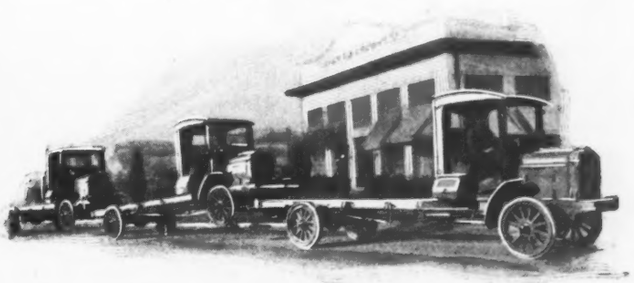
Every year the mistletoe shrub attacks large forests of larch, yellow pine, and Douglas fir, overgrowing the trees and stunting their growth, until the lumber becomes almost unsaleable.

CHEMISTS have found that sodium fluoride and borax will protect wood pulp from decay. The discovery is expected to increase the durability of paper and prevent coarser papers from turning yellow after exposure to the air.

Three Trucks—One Driver

BY clamping a six-by-six inch timber under the chassis frame of one truck just in front of the radiator, and placing this on a greased wooden bearing surface on the rear of a truck ahead, with a loose bolt between the two as coupling, one man was able recently to drive three motor-trucks from the factory at Oakland, Calif., to the distributor in Los Angeles, a distance of 500 miles.

Though the front wheels of the two trailing trucks were lifted clear of the ground by this method, the smoothness of the roads and the care with which the first car was driven made the trip uneventful. The trucks were delivered three days sooner than if they had been shipped by freight, and the cost of delivery was $40 instead of $175 or more.



How two trailing trucks, with front wheels raised, were hitched to a lead truck and driven by one man

What Causes Colors in the Sunset Sky?

Here Are Ten Everyday Wonders that Unlock Secrets of Science

EVERY month POPULAR SCIENCE MONTHLY publishes 10 questions about the scientific facts back of our daily lives. Find out from the answers on this page how well you really understand the fundamentals of science that every one wants to know.

1. **What causes the sunset colors in the sky?**
2. **Why do we breathe faster after strenuous exercise?**
3. **Why is the water at the bottom of the ocean always at a temperature of 4° C.?**
4. **Why does bread crust taste different from the inside of the loaf?**
5. **What causes rain? Can man cause rain to fall?**
6. **What is meant by a "32-candlepower" lamp? By foot candle?**
7. **Why do workmen often lower a lighted lantern into a well or excavation before descending into it?**
8. **How does heat from a radiator reach you across a room?**
9. **Why is nitrogen called an "inactive" element?**
10. **Why does a short phonograph needle produce a louder sound than a long one?**

Read the answers below

Five Minutes a Day Will Make You Master of These A-B-C's of Science

Colors in the Sunset Sky

1. Sunlight, or any other white light, is a complex of many colors. When a ray of sunlight is allowed to pass through a narrow slit and through a glass prism, it is broken up into its component parts.

A similar result is obtained when at sunset the sun's rays pass obliquely through a thick layer of our atmosphere heavily charged with water vapor and impurities that act as a prism and refract the sunlight, breaking it into its component colors.

Why We Breathe Faster

2. The oxygen that enters our lungs replenishes the oxygen supply of the blood. In strenuous exercise, our bodies use up more than the usual amount of energy. The impoverished blood needs replenishment of its oxygen supply, and it is this need that stimulates an increase in the rate of breathing.

Water at the Ocean Bottom

3. Most substances shrink when they are cooled, and hence become denser. Water, however, when gradually cooled, gains in density only until its temperature reaches 4° C.; then it begins to expand and continues growing lighter until it becomes solid ice at zero.

The densest or heaviest water will naturally sink to the bottom and, since it reaches its greatest density at 4° C., the water at the bottom of the ocean must have this temperature.

The Taste of Bread Crust

4. The water in dough changes to steam when the inside temperature reaches boiling-point—212° F.

The outside of the loaf is not limited by the presence of water to this maximum temperature. The pan containing the loaf, and the air in the oven, reach a much higher temperature, which converts the starch in the outer layers of the loaf to dextrin, a form of sugar, part of which is still further changed to caramel, which gives the crust its flavor.

What Causes the Rain

5. When warm air, charged with water vapor, rises and reaches a colder stratum of air, the moisture condenses around small particles of dust carried up from the earth. If conditions are favorable, some of these infinitesimally small drops coalesce with other drops until they become so heavy that the air current can no longer support them. When they fall through the clouds, they attract more drops and grow to the size of raindrops.

Scientists seem to agree that artificial production of rain is theoretically possible, but impracticable.

Candlepower and Foot Candle

6. Candlepower is the unit by which intensity of light is measured—that is, the intensity of illumination provided by a standard candle. Electric light of the 60-watt, Tungsten variety gives an illumination equal to about 32 standard candles.

The amount of light a person receives from one candlepower at a distance of one foot is defined as "foot candle."

Lantern Warns of Danger

7. Carbon dioxide, which tends to settle to the lower strata of our atmosphere, does not support combustion, since it cannot give off any free oxygen. If a lantern, lowered into a well, goes out, it indicates the presence of heavy gas that will not support breathing and the oxidation of the blood in the lungs.

Heat from the Radiator

8. There are two ways in which heat travels across a room—convection and radiation. By convection, warm air above the radiator rises. Colder air rushes in and is warmed in turn. Thus is established an air current that eventually brings every bit of air in the room in contact with the radiator.

In radiation, the radiator sends out heat waves, similar to light waves, that are absorbed or reflected when they strike objects in the room.

Nitrogen Dislikes Company

9. Referring to nitrogen as an "inactive" element, means that it belongs to a comparatively small group of elements that not only seem to have no desire to combine with other elements, but actually resist any attempt to force them into combination.

Only by extraordinary means can nitrogen be compelled to combine with other elements to form a stable compound. Its desire to break the bonds that tie it to other elements manifests itself in violent explosions.

Sounds from the Phonograph

10. Movements of a phonograph needle are transmitted to the diaphragm or soundbox. Vibrations of the diaphragm produce the sound of the phonograph, and the more violent the vibrations the louder the sound. The lever connecting the needle with the diaphragm is pivoted at a point closer to the needle than to the diaphragm. In effect the point of the needle is at the short end of a seesaw and the diaphragm on the long end. Thus a minute motion of the needle will cause the diaphragm to move a great deal.

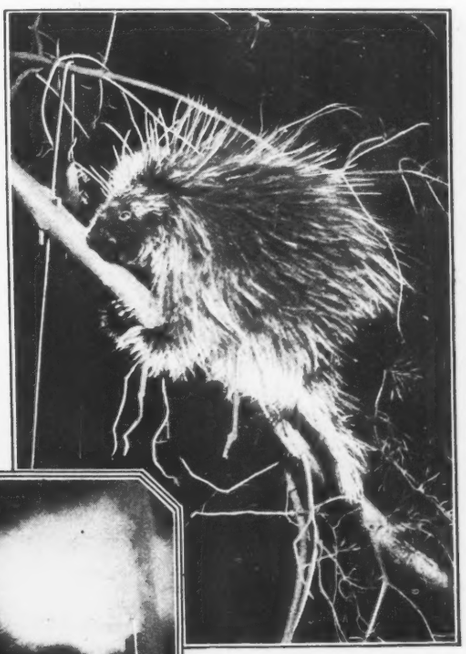
The shorter the needle, the more will its vibrations be amplified in the diaphragm.

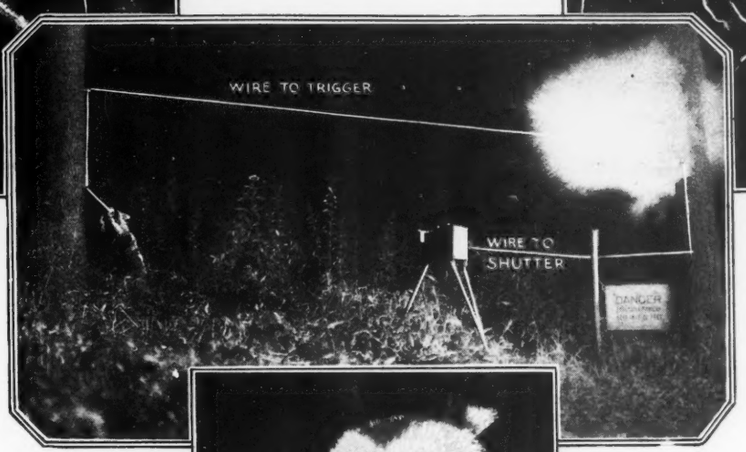
DOES one of these Everyday Wonders suggest some question that puzzles you? Our Information Department will gladly answer your inquiries on general scientific subjects. Full details of this service on Page 28.

It's Always Open Season for the Flashlight Hunter

Armed with a Camera "Gun," You Can Induce Wild Denizens of the Woods to Snap Their Own Photographs

WITH wire and bait you can rig up a "flashlight gun," like that shown below, to photograph wild animals. The animal grasps the bait attached to the wire, releasing the camera shutter and flashlight. Your success will depend on the bait, which must be attractive to the animal whose picture you desire.





MOUSE WAS TEMPTING

Horned owls, found in nearly all parts of the United States, hunt at night. They feed on mice and other rodents, but also, unfortunately, on birds and useful animals

HIS DIET IS VARIED

Like the owls, porcupines hunt mostly at night, but are not considered a serious danger to bird life. Field mice and other small rodents constitute part of their mixed diet

MUCH DISLIKED, BUT USEFUL

Few animals are more disliked and have a worse reputation than the American skunk. Primarily he is an insect eater and as such is useful. He does not confine himself to insects, however, but eats small rodents, frogs, and in rare instances eggs and even young birds

A FOE OF THE FARMYARD

The fox is still found occasionally in the wilder parts of the country and in woodland farming districts, where he constitutes a serious menace to domesticated fowls. He hunts at night, preferably in chicken-yards and duck-ponds, and is also fond of young rabbits and wild birds

Why not carry a flashlight gun on your automobile camping-trip this summer?

Blind Sailor Types without Fingers

With the stumps of his arms he guides a spring punch that hits the keys, while pedals operate shift-key and spacer

SIGHTLESS, and with both hands off at the wrists, Carl Bronner has taught himself to be an expert typist.

Aided by a machine built especially for his use by the instructors of the Red Cross Institute for the Blind at Baltimore, Md., this wounded veteran of the naval service goes about his tasks cheerfully and confidently. Recently complimented by President Harding on his progress on the typewriter, Bronner replied that he intended to master the study of law after completing his training in the Veterans' Bureau.

Two special attachments distinguish Bronner's typewriter from the ordinary machine. By means of wires leading to pedals from the spacer bar and the shift-keys, he can move these with his feet. To enable him to strike the letter keys, a metal gate pivoted on the base of the typewriter swings back and forth over the four rows of the keyboard. This gate is guided by a bar having four notches, so that it may be stopped over any row. Along the top bar of the gate slides a spring - punch, which fits into notches corresponding to the keys in the row over which the punch is suspended.

Bronner strikes a letter by depressing the punch. He guides the punch to the proper letter by sound, counting the notches as they click by. The letter "r," for example, is the eighth click from the left on the second row.

Naturally, he types slowly, but he is astonishingly accurate. The form and appearance of his letters are said to be equal to those of a typist aided by eyes and fingers, and the same courage that enabled him to master the typewriter will undoubtedly make him achieve his second ambition of the law.

One Umbrella Handle Holds Many Covers

IT'S easy for women to keep their umbrellas in style and to match their parasols with their gowns now that a detachable umbrella handle has been invented by Miss Beulah Henry, of New York City. Covers of any or many colors can be used with a single handle.

In attaching a cover, the first step is to run the hollow tip over the end of the rod.

© Keystone

To fasten the cover over the ribs requires only a few seconds

The ferrule fastens automatically with a small clip, and other specially designed clips, the feature of the invention, fasten the cover to each umbrella rib.

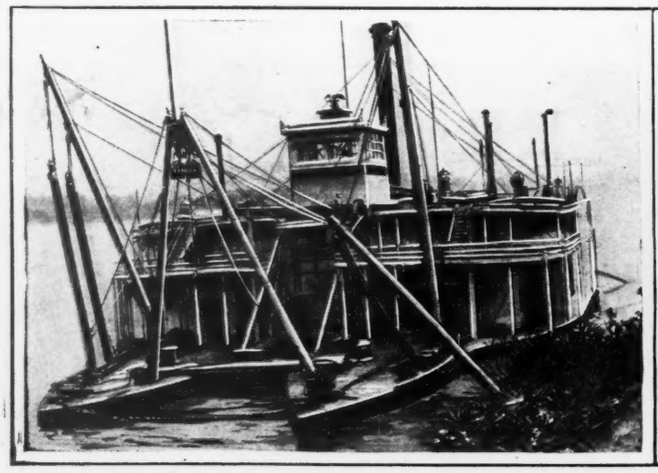
Missouri River Snagboats Clear Way for Barge Traffic

IN order that barge lines now operating on the Mississippi can be extended to tap the great wheat-growing region of the West, snagboats in charge of army engineers are now performing valuable work in making the Missouri River navigable between Kansas City and St. Louis.

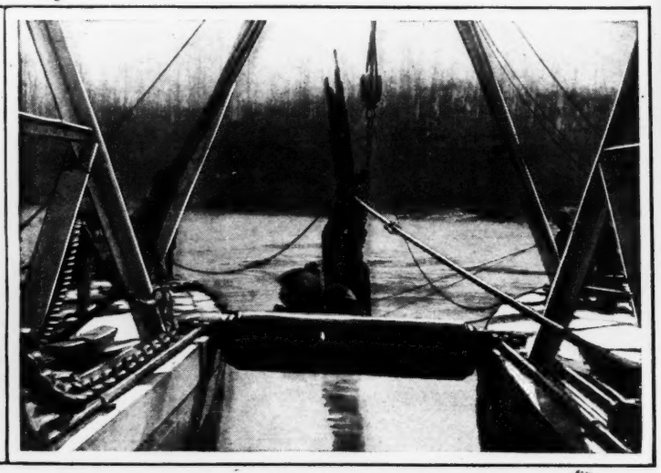
The task of removing snags from the Missouri is no small one, for after every high water, great trees washed from the banks become embedded in the bottom of the river. They thrust their splintered trunks upward, often with the sharp tip only a foot or two below the surface.

The typical snagboat is 190 feet long by 90 feet beam, with a steel hull that is divided into a double prow. Over the divided bow are heavy triangular shears, carrying threefold blocks through which the hoisting lines pass.

In removing a snag, a chain is fastened around the tree-trunk, and the boat backs, dragging the snag bodily from the stream. A tackle leading from the shears then hauls the log on board, where it is laid across the bow and cut into short lengths by a band-saw. These small lengths are permitted to drift downstream. The stump of the log is picked up by a crane on the bow and tossed to the bank of the river.



Above the space between two prows are heavy triangular shears carrying blocks and tackle for hauling logs aboard



A dangerous snag is pulled from the river. After a chain is attached to the stump, the boat backs away

Shall We Throw Away Our Glasses?

"Relax Your Eyes! Stare at the Sun!" Are Among Experts' Recipes for Curing Eye Troubles without Spectacles

By Ralph R. Perry

TWO out of three of you who read this should be wearing eyeglasses, according to recent statistics and to all the accepted theories of optics and the physiology of the eye.

"None of you should wear glasses!" according to Dr. William H. Bates, a well-known oculist of New York City, author of "Perfect Sight without Glasses," and attending physician in a clinic at the Harlem Hospital. "You need rarely wear glasses unless you choose," his theory runs, "for defective vision, even in some forms pronounced incurable, can be cured by rest and relief from strain through a simple series of exercises you can practice in your own home."

Doctor Bates focuses a shaft of light from a pocket burning-glass on the patient's eyeball just above the pupil. The effect is to soothe the eye and eliminate strain

A Begoggled People

Here are two flatly contradictory views. The doctors disagree. But about one fact all must agree, and that is that we Americans are rapidly becoming an eye-troubled, begoggled people. Frenchmen and Englishmen are said to be amazed at the number of Americans who find it necessary to wear glasses. According to conservative estimates, two thirds of our population, or more than 66,000,000 persons, suffer from troublesome eye defects.

In a recent survey of the men employed in 101 large factories, optical tests showed that 53 per cent possessed eyes so poor as to impair their health and working efficiency; that 13 per cent were already wearing glasses, and that only 33 per cent enjoyed normal vision. The number needing glasses checked almost exactly with another survey, completed independently, among school children in Philadelphia. Here the survey revealed that only 7½ per cent enjoyed perfect sight; four per cent suffered negligible defects, making them just short of perfect; 88½ per cent had slight faults, and of these faults 66 per cent were refractive errors that would soon necessitate the wearing of eyeglasses.

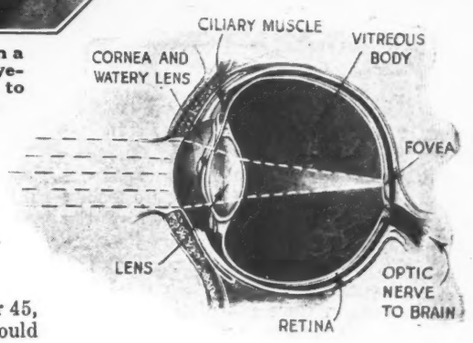
If the accepted theories of vision are correct, then, almost every one over 45, and two younger people out of three should wear glasses. This Doctor Bates denies, and he bases his contention on what is called the "theory of accommodation."

What is meant by accommodation? Normally, the eye is focussed to see objects at a distance. The rays of light are parallel as they reach the eye, and are focused on a small spot in the retina by passing through three sets of lenses. But when you look at an object near by, like a printed page, from which the rays are divergent, the eye changes, or "accommodates" its focus for near vision. Exactly what happens inside the eyeball during this process has never been known precisely, but for the past 70 years the accepted theory has been that the front surface of the crystalline lens bulges out, increasing the curvature of the lens and shortening the focus.

In accommodation, oculists have said, the little ciliary muscle at the corner of the lens relaxes, and the lens swells outward through its own elasticity.

This statement is based on experiments performed by Hermann Helmholtz, of Germany, about 1851. If a candle is placed near the eye, an observer will see three images of it in the eyeball, reflected from the surface of the cornea and the front and back of the crystalline lens respectively. Helmholtz said that when the eye accommodates for near vision, the image reflected from the front of the crystalline lens becomes smaller and moves closer to the others—as would be the case if the curvature of the front of the lens had increased. Scientists believe that the ciliary muscle causes this change simply because there is nothing else present that can cause it. Your glasses are prescribed in accordance with this theory of accommodation.

Doctor Bates claims that the theory is wrong, as are the glasses. For after four years of daily effort, he succeeded in taking the first photographs ever made of these reflections in the eye. Careful measurements of the negatives revealed, he says, that the shape of the front of the lens did not change during accommodation, but that the shape of the eyeball did! In brief, by repeating Helmholtz' experiments under more scientific conditions, Doctor Bates reaches a totally different conclusion. His photographs suggest that the eye accommodates by changing the length of the eyeball, exactly as a camera focuses when the bellows is moved in and out.



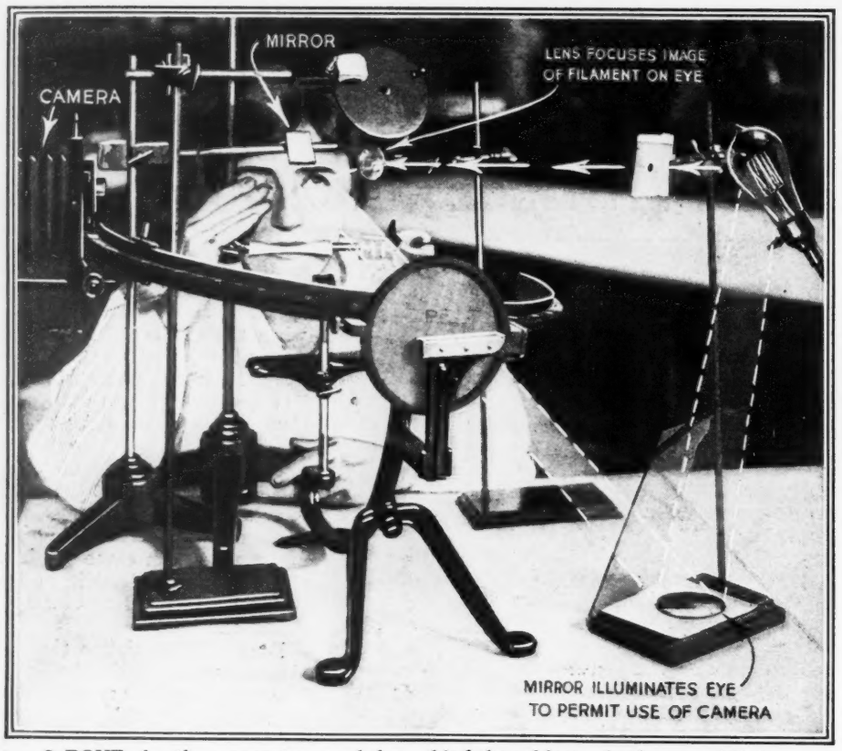
Distortion of the entire eyeball rather than of the lens alone permits accommodation to near and far vision, according to the new theory

Patients with normal sight have been able to gaze at the sun for fully an hour without discomfort, says Doctor Bates, only to find their vision improved

What the Rabbit's Eye Showed

For further proof, he removed the lens from the eye of a rabbit, and proved that the rabbit's eye accommodated for near vision. Again, he points to the occasional human sufferer whose crystalline lens has been removed to relieve cataract, and yet who still is able to read without special glasses for near sight.

Accommodation, says Doctor Bates, instead of being caused by the tiny ciliary muscle, is produced by the six large, strong muscles on the outside of the eyeball, which turn the eye in its socket. By cutting these muscles, he claims to be able to prevent accommodation, and to produce



ABOVE is the apparatus used by Doctor Bates in photographing images reflected from the eyeball during accommodation. On the small rectangular mirror in front of the subject are pasted small type letters, while in the mirror is reflected a test-card 20 feet behind the subject. As the eyes shift from far sight to near sight, focusing first on the reflected test-card, then on the small type on the mirror, the camera registers the images of the filament reflected from the eyeball. Thus an exact record of accommodation is obtained.

experimentally any form of eye trouble, whether short sight, far sight, or astigmatism. The muscles work in pairs, and provided the proper relation is preserved between them—that is, if there is no feeling of effort or strain—examination by the retinoscope will show that the eye has perfect sight. Refractive errors are not the result of permanent deformations of the eyeball, but, in the light of these experiments, are temporary, functional changes caused by strain.

As the shape of the eyeball is constantly changing, by exercising the proper control the patient can change the focus of his eyes by mental exercise until he sees perfectly.

As a spectacular demonstration of what a person with perfectly trained eyes can accomplish, many of Doctor Bates' patients look directly into the sun at midday without discomfort. Tradition has it that only the eagle can face such intense light; yet the testimony is that Mrs. Emily C. Lierman, of New York City, has gazed directly at the sun for 62 minutes, and then, instantly looking across the room at an oculist's test-card, has been able to read a line of type at a distance twice as great as it can be read by persons having the so-called normal, or 20-20, vision.

Treatment by Light Eases Strain

In certain conditions, Doctor Bates used bright light as a means of bringing about relaxation through which he effects his cures. Although he believes that we are wrong to fear bright light so greatly, gazing at the sun is no part of his ordinary treatment. Where a patient finds it impossible to refrain from staring and straining, however, he is seated in a chair in the sunlight, or under a powerful electric light, and told to gaze at the floor. The doctor then focuses a shaft of light upon the eyeball, just above and about the pupil, with a pocket burning-glass. The effect on the patient is very soothing—the eye seems to be bathed in a stimulating fluid, and it is afterward easier to avoid the sensation of strain.

The keynote of the new system of cure is to avoid strain. Any eye that is straining, according to these theories, will have a refractive error such as short sight, and any eye that is neither straining nor staring will have perfect vision.

But, if you are one of the 66,000,000 who are troubled with eye strain, how can you set about curing yourself? Admitting Doctor Bates' discoveries, the action of the muscles controlling accommodation and the shape of the eye is involuntary. For this reason they must be trained by the conscious use of the mind, and imagination.

The following are his more interesting rules for better vision without glasses:

How to Train Your Eyes

"First, rest. Close your eyes, and cover them with the palms of your hands, shutting off all light without pressing upon the eyeball. Think of the blackest thing you can imagine. Keep this up till your eyes are rested. Then open them quickly, and glance at a single letter on an oculist's test-card—the smallest you can see clearly from where you sit. Remembering the black color, close your eyes again and repeat. See whether your vision does not improve the instant you open your eyes.

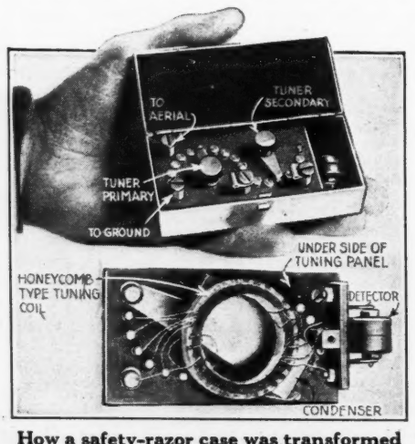
"Next, train your eyes to focus upon the fovea, the central spot in the retina where the power of sight is most acute. Shift the eye from one letter on an oculist's test-card to another and notice that the letters appear to move in the opposite direction to the shift of the eyes. This exercise breaks you of the habit of staring, and staring is bad because it makes the center of fixations, or focus, move from the fovea to the edge of the retina."

[Problems of eyesight have become so acute in our schools and shops that a national Better Vision conference of distinguished experts was recently held in New York to devise means of meeting it. The foregoing is presented as an interesting sidelight on this problem, POPULAR SCIENCE MONTHLY refraining from taking issue on controversial points.—THE EDITOR.]

THE chances are you have astigmatism. It is the commonest of eye troubles, but the least likely to be recognized by the sufferer. Instead of resulting in blurred vision, it may show itself only in frequent headaches. But the pictures on the opposite page show what the world will look like to you if a severe astigmatic tendency is not corrected.

Razor-Case Becomes a Pocket Radio Set

FROM a safety-razor case and 75 cents' worth of material, C. H. Shipton, of Seattle, Wash., has just finished making a pocket radiophone receiver.



How a safety-razor case was transformed into a pocket radiophone receiver

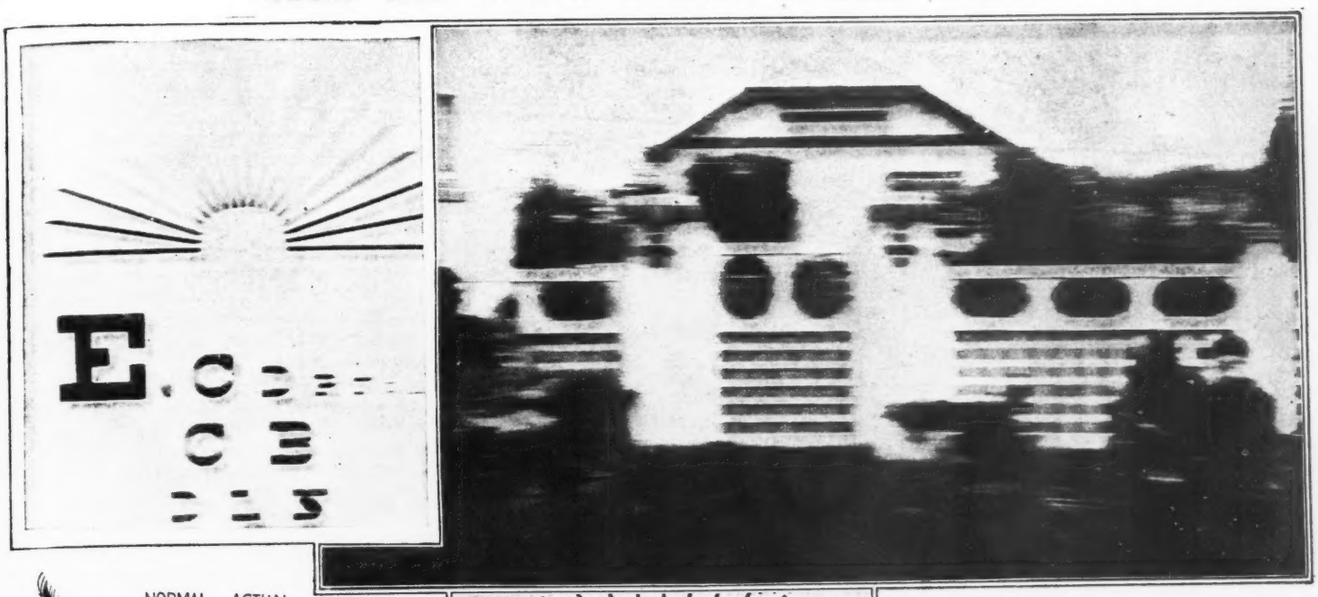
With a three-wire fan-type aerial 80 feet long, the radio bulletins come in so loud, Shipton says, that he can hear them 10 feet from the set.

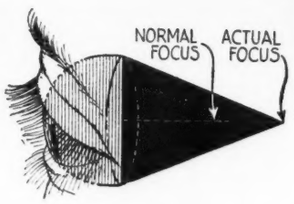
The turning coil for varying the wave length of the wireless waves is only 1⅝ inches in diameter. It was wound by hand.

Shipton uses a crystal detector made of two tiny fiber cups placed against each other and revolving on swivels. With a piece of galena placed in one of the cups, they can be tuned by hand so that the most sensitive points of the crystal can be reached. The cups themselves are one half inch in diameter.

Shipton carries the pocket receiver wherever he goes, and by attaching it to the iron wire brace of any telephone pole and dropping a wire to the ground, he can pull down radiophone messages, the day's news, or entertainment from the ether.

The Commonest Eye Trouble—Astigmatism. Here's How the World Looks to Bad Cases





Vertical Astigmatism

IF the lens combination of the human eye is not symmetrical in all axes, it produces a defect of vision called astigmatism—the commonest of eye troubles. In a majority of cases the abnormal condition is confined to one axis.

In vertical astigmatism the horizontal curvature of the lens combination is normal, so that all horizontal or nearly horizontal lines are brought to a clear focus, while the focus of all vertical or nearly vertical lines is formed in front of or behind the retina and hence all vertical lines appear blurred and hazy.

An eye with vertical astigmatism will see the house and oculist's test card as in the pictures above. The schematic drawing explains the condition of the eye in a case of vertical astigmatism.

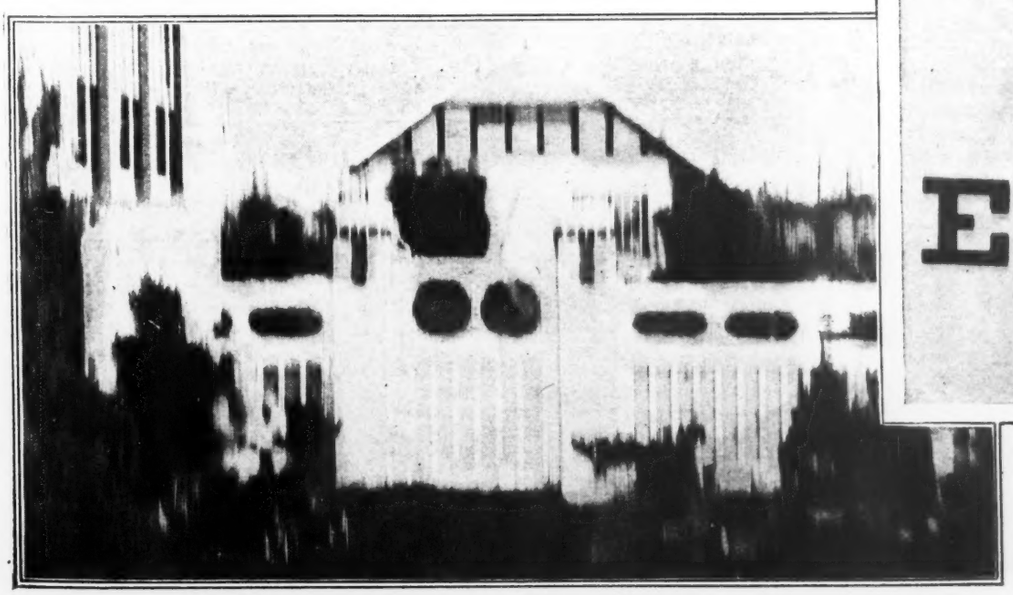
To the eye with normal vision the house will appear clear and without distortion in all planes, as will the lines and letters of the test-card

Horizontal Astigmatism

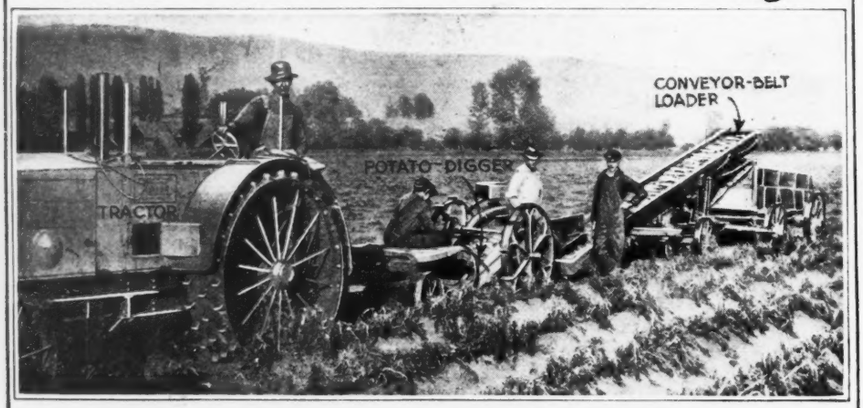
IN horizontal astigmatism the vertical curvature of the lens combination of the human eye may be perfectly normal, bringing all vertical or nearly vertical lines to a clear focus on the retina. But the curvature in the horizontal plane is abnormal and all rays in that plane come to a focus in front of the retina or behind it, as the case may be.

The eye will see all vertical lines clearly, while all horizontal lines will appear indistinct and blurred.

The pictures below show how an eye-testing chart and a house appear to the eye afflicted with horizontal astigmatism. The drawing pictures condition of the eye. In such an eye the focus in the vertical axis of the eye is normal, while that of the horizontal axis is abnormal and does not make it possible to obtain a clear impression of horizontal lines on the retina.



Potatoes Climb from Ground into Wagon



HARVESTING and loading root-crops, such as beets and potatoes, into wagons has been greatly facilitated by a conveyor system invented by E. C. Lehson, of Missoula, Mont. Immediately behind the digger is attached a troughlike frame slanting from the surface of the field to the body of the wagon.

The uprooted vegetables fall on the bottom of a belt conveyor, and are lifted into the wagon automatically, making harvesting a completely automatic process.

The conveyor belt is driven by rollers turned by a chain and sprocket gear leading from the wheels of the loader. No auxiliary engine is needed.

As an example of the machine's performance, three men and two boys have dug and loaded 41,200 pounds of potatoes in a single working day. The total expense for handling the potatoes was approximately three cents a hundred pounds.

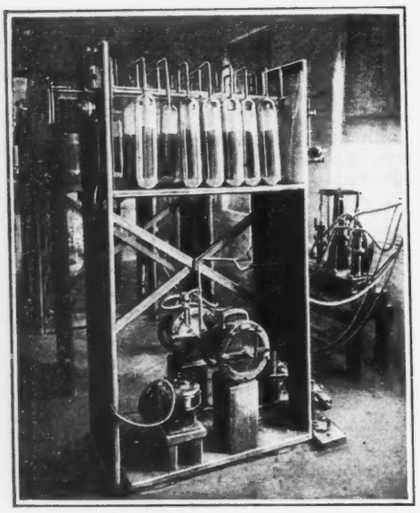
Amateurs Use Balloons to String Wireless Antennae

BALLOONS to carry up wireless antennae, of the kind tested by several governments during the war, are now being used by amateurs with satisfactory results. By running a single wire to approximately the wave length it is desired to receive, signals otherwise inaudible can be picked up, it is said, without the use of amplifying devices.

As the balloon rises, a marked increase in the intensity of signals can be noted. In fact, one authority states that a single wire antenna carried up 600 feet will render an outfit using a crystal detector as efficient as the military reconnaissance set with its vacuum tube detector and one stage of amplification.

The balloon is intended only for use on special occasions or where there is no time to provide the usual aerial. Great care must be taken while the balloon is in the air to prevent it from damaging itself against trees or telegraph poles. The method found most satisfactory is to hold the balloon steady with guy ropes.

Preparing to send up their balloon to catch air messages



Cotton Samples Preserved in Huge Vacuum Tubes

THE official cotton standards of the United States, in comparison with which experts grade each year's cotton harvest, are preserved by the Department of Agriculture in what are believed to be the largest vacuum tubes in everyday use. The containers are cylindrical in shape, with a diameter of 3½ inches and an over-all length of 18 inches.

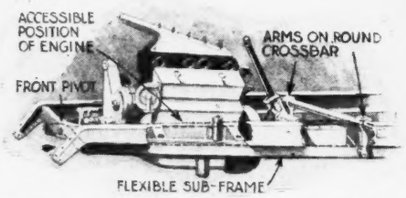
In order to protect the cotton against deterioration, a new sample is first rolled in pure filter paper, then wrapped in a pure black carbon paper, and placed in the unsealed tube on top of a wad of common cotton. A second wad of cotton packing is inserted, and finally into the top is packed a quantity of asbestos that has previously been fused at about 900° Centigrade for 25 minutes to destroy all germ life.

When the sample has thus been prepared, oil and mercury pumps reduce the air pressure in the tubes to two millimeters of mercury and the tubes are sealed. The standards are stored finally in a fireproof vault where the temperature is constant.

Flexible Suspension Saves Engine from Injury

INJURY to the power plant due to distortion of the main frame is prevented in a new British truck by hanging the engine, clutch, and transmission to a flexible subframe.

In this novel mode of suspension, the subframe is pivoted to a front cross member, and its rear corners are suspended from arms swinging on another round cross-member attached to the main frame.



How the engine, clutch, and transmission are hung on a flexible subframe

Advantages of this arrangement are that it makes engine, clutch, and transmission accessible, affords protection against damage and far greater ease in repair.

Disease Germs Fight Rats in New York Zoo

They scatter germ-covered bread where the rats will find it

GERMS of a contagious disease fatal to rats and mice, yet so carefully graduated that they will not harm men, or even other rodents, such as squirrels and chipmunks, are being used to kill rats and thus clear the New York Zoo of one of its worst pests.

Small pieces of bread are covered with a bacterial culture and placed, in paper envelopes, where the rats will be likely to find and eat them. Thereafter a disease resembling influenza not only kills the rat that eats the food, but is communicated to all other rats with which the sick animal comes into contact. The new method promises to be far more effective than any poison heretofore used.

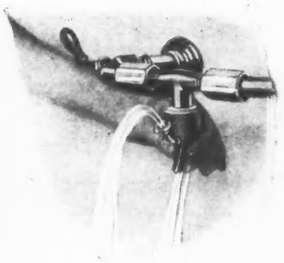
Let a Motor Wash Friend Wife's Dishes

FOR CAKE SHELLS

This pan, stamped from a single piece of aluminum, is ideal for baking cake shells, which may be filled with preserves or other dessert filler

MOTOR-DRIVEN ARMS DO THE SCRUBBING

Here's a new portable dishwashing machine for the small apartment. The machine is raised to sink height by a pedal. A motor revolves a central, vertical tube with radial arms that throw the water at the dishes by centrifugal force. After five minutes' washing, the container is emptied and refilled with hot water for rinsing

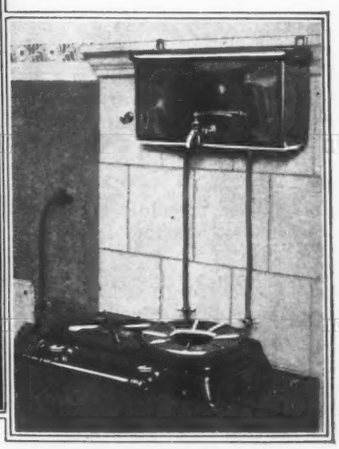


KITCHEN FOUNTAIN

When the lower, open end of the rubber tube is compressed, filtered water flows from a kitchen sanitary fountain formed by the faucet attachment

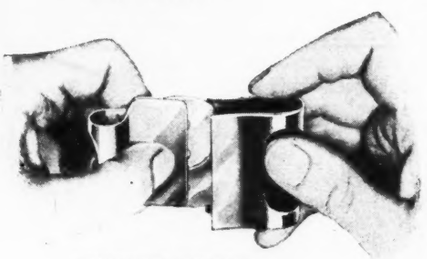
NEW ECONOMY HEATER

This fuel-saving stove can be used as a cookstove, or the heat-radiating cylinders will transform it into a heater



GAS-STOVE HEATS WATER

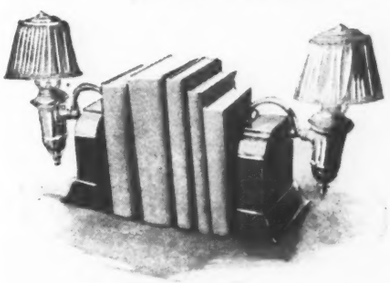
Cold water from the wall tank flows into the coil of the ring-shaped heater on the gas-stove and returns, heated, to the tank



HANDY RAZOR SHARPENER

Draw the safety-razor blade between the rubber pads, covered with fine abrasive, pressing the pads against the blade. Repeat to obtain a fine edge

AS a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in POPULAR SCIENCE MONTHLY.



LIGHTS FOR THE BOOKSHELF

Each bookend holds an ornamental electric lamp with a conical shade. A wall plug supplies the current

ELECTRIC HEATING-PAD

One advantage of this electric heating-pad over the hot-water bag is that it cannot leak. It may be set for three different degrees of heat

NEAT EGG-CRACKER

The handle presses the egg on four points of stellite. When the handle is released, the points spread, breaking the egg

ORNAMENT IS LIGHT SOCKET

The tassel is not merely a chandelier ornament. It contains a socket for connecting the plug of your lamp, toaster, or vacuum cleaner with a light fixture

What Are You Afraid Of—and Why?

Experiments Reveal that Every "Grown-Up," Acquiring Host of Fears, Becomes More of a "Baby" than a One-Year-Old

By Wilfred S. Ogden

THE discovery that babies are born without fear, and remarkable revelations of how the hampering fears that dog every human's footsteps later in life arise, have resulted from a unique series of experiments recently undertaken by Dr. John B. Watson, a noted New York psychologist.

If you are honest with yourself, you will discover that you are more often frightened by simple objects and circumstances than you like to admit. Psychologists have discovered an amazing list of fears that plague grown men and women—fear of the dark, fear of open places, of heights, of lightning and thunder, of sudden noises, or of snakes, rats, and cats.

When Was Fear Born?

Whence arise these ridiculous "phobias," as the psychologists call them? Why should they make life miserable for apparently strong-minded adults? Doctor Watson's discovery of an explanation may help us bring up future generations in greater freedom.

The problem is important not only because the victim of fear is notoriously a loser in the battle for success, but also because the shocks of repeated fears upset digestion and other normal processes of the body. A sudden fright produces an amazing series of physical reactions, all of which are interestingly explained elsewhere on these pages as having been important to our primitive ancestors, but which, constantly repeated, can only be harmful to men living at the high nervous tension of modern life.

Doctor Watson's theory is in part as follows:

Your fears are not your natural birthright; nor did they "just grow." Most of them were taught you by your parents and other "grown-ups"—almost before you were out of creepers.

Almost every common fear that you can think of has developed from, or has been "conditioned" on, some previous fear. That fear, in turn, has been conditioned on still another fear. Thus, your pet horrors and aversions have multiplied in steady progression, as the years have gone by, from two fundamental fears that startled you and made you cry when you were a helpless baby. These, Dr. Watson's experiments have revealed, were: 1. Loud sounds. 2. Falling, or sudden removal of support.

In tracing the real causes of fear, Doctor Watson has reached these conclusions in his experiments:

Babies are far braver, far less fearful, than adults.

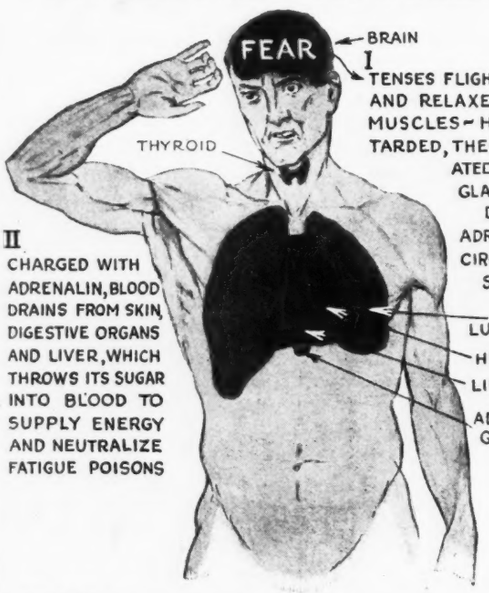
Children learn to be afraid just as they learn the letters of the alphabet—from their elders. If you want your son or daughter to be fearless, devoid of unreasoning terrors, such as those called forth by a kitten or a snake, you must train the child carefully up to the age of two.

Character Formed Early

When an infant is two years old, according to these new discoveries, its fundamental character is already formed. It has already become fearless or timid, active or indolent. The general pattern of its character, the emotional nature that will make or break the adult, has already been laid down.

The child of five, Doctor Watson has

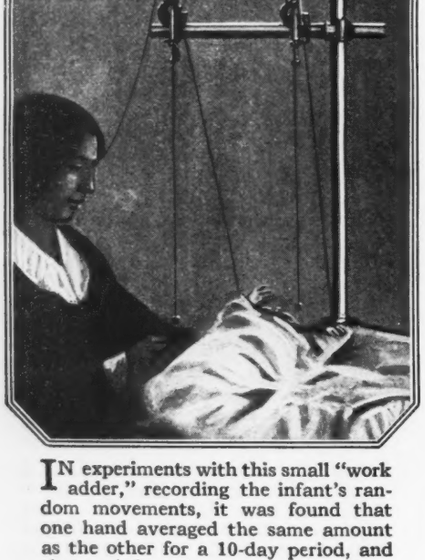
How Fear Strains Our Mechanism


FEAR
BRAIN
I
TENSES FLIGHT MUSCLES AND RELAXES FIGHT MUSCLES—HEART RETARDED, THEN ACCELERATED—ADRENAL GLAND EXCITED, DUMPING ADRENALIN INTO CIRCULATORY SYSTEM
THYROID
II
CHARGED WITH ADRENALIN, BLOOD DRAINS FROM SKIN, DIGESTIVE ORGANS AND LIVER, WHICH THROWS ITS SUGAR INTO BLOOD TO SUPPLY ENERGY AND NEUTRALIZE FATIGUE POISONS
LUNGS
HEART
LIVER
ADRENAL GLAND

FEAR is the automatic, instinctive response of our human mechanism to a danger signal—an instantaneous summoning of every resource of the body for self preservation. Its mechanism is described in the diagram.

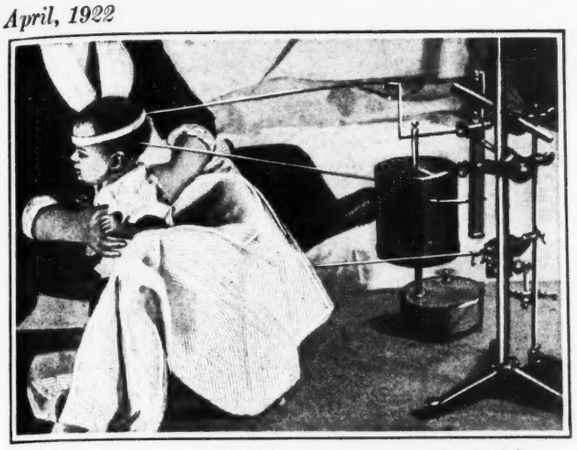
At the alarm, the nervous system flashes an S.O.S. call to every part of the organism. The blood rushes from the skin, the digestive organs, the liver, and spleen, to the front lines of defense—the brain and muscles.

Heart action is stimulated; blood pressure rises; the skin becomes pale; cold perspiration is exuded; the muscles shiver; breathing is hurried; digestion is suspended; the mouth becomes dry; and the liver exhausts itself to energize the body by throwing its sugar resources into the blood.



IN experiments with this small "work adder," recording the infant's random movements, it was found that one hand averaged the same amount as the other for a 10-day period, and that an infant that is right-handed today is likely to be left-handed tomorrow. The "work adder" consists of a cord leading from the baby's wrist to an escapement device that causes a toothed wheel to revolve in one direction. This wheel is connected with a drum to which is fastened a small weight. As the child makes its random movements, the weight is wound higher and higher from the ground

Until the sight of the rabbit was accompanied by the sound of a hammer on a bar, the baby showed no fear



Lines on the smoked drum measure the child's ability to hold its head steady—one method of testing for normal intelligence.

found, is enormously sophisticated. By the time it enters the kindergarten, it has developed fears and habits that can be eradicated later only with difficulty.

Doctor Watson performed his experiments with infants born in hospitals, where they had been carefully protected from all outside influences. In age they varied from less than four months to one year.

Babies Show No Fear

As one of the methods of determining the cause of fear, each infant was seated in the lap of its mother, and a live animal, hitherto concealed, was suddenly thrust into its arms. Without exception each child crowed with pleasure and patted the animal. Whether it was a cat, a dog, a rabbit, or a white rat, seemed to make no difference. None of the children was naturally afraid of it. The same was true of fire. A baby, the doctor discovered, will reach for a candle until burned fingers teach it not to handle flame.

But if the baby was dropped to a pillow, or even if the experimenter tugged at the blanket on which it was lying, the result was quite different. Fear was invariably produced. The baby's muscles became tense; it sought to crawl away, and if the stimulus was repeated, it cried. Similar reactions were obtained by making a loud noise, usually by striking an iron bar with a hammer.

"But how can we square these observations with the facts of adult life?" asked Doctor Watson.

His final conclusion was that we learn to be afraid as we grow older; for nearly all grown-ups possess fears attached not only to noises and falls, but to animals, persons, places and even general situations. These secondary fears are caused, declares Doctor Watson, by a psychological process called "the conditioning of reflexes." To prove this, he actually developed a fear in one infant, doing under scientific conditions just what parents, through lack of proper supervision, unconsciously permit children to do. The tests were performed with "Albert," a child aged 11 months and three days, as the subject.

Repeated tests revealed that Albert at the outset feared nothing but loud noises and the removal of support. He played with a white rat without the slightest display of terror. From this point the fear-developing experiments proceeded.

Confronted by a white rat, the baby at first crowed gleefully, proving himself naturally without fear

The white rat was again shown to Albert, but this time as he reached for it, a bar behind him was struck with a hammer. Instantly the baby started and began to cry. He was not afraid of the rat, but he did fear noise.

A week later, the white rat was shown him again. He hesitated for an instant then reached for it once more. When the bar was struck, he recoiled in terror.

A short time later the rat was shown to him, with no accompanying sound. Instantly the baby began to cry, then raised himself on all fours and crawled away.

One Terror Begets a Hundred

The child's first terror of a noise had been transferred, by teaching, into real fear of an animal. And—more significant still—Albert had become afraid, not only of white rats, but of practically all animals. He had even learned to fear anything furry, such as a sealskin coat or a false face, donned by the experimenter. From two fears, he had quickly developed hundreds. A little patient training removed these fears and before long he was playing with the rat again.

"We thus see how easily such conditioned fears may grow up in the home," Doctor Watson observes. "A child that has gone to bed for years without a light with no fear, may, through the loud slamming of doors, become conditioned to darkness."

Character also is affected, the experiments indicate, because by limiting the number and kind of objects with which a child deals, the acquired fears tend to limit or prevent the formation of constructive habits. To that extent, they modify his vocational future.

"It is ridiculous," says Doctor Watson, "to pretend that we can choose a suitable career for a child while it is in the cradle; that we can determine whether it should become a doctor or a plumber. The most careful study of a child one year old cannot determine the details of his adult life. This does not mean, however, that emotions and habits developed before the age of two years will not outline the broad elements of the child's profession."

What careful training can do, the experiments indicate, is to provide the baby with a chance to develop his natural capacities unchecked by unnecessary fears and inhibitions.

When Doctor Watson donned a false face, the child at first showed more interest than fear

IF you are a victim of Fear, you are handicapped in the battle of life. Famous psychologists, such as William James, have found it impossible to detect the utility of many strange and hampering fear reactions that afflict man.

In the bodies of our primitive ancestors, however, the automatic mechanism of fear was essential. It provided quick mobilization of bodily resources for attack or retreat.

Today, most of the dangers that beset primitive man have vanished; still, each of us acquires in early childhood an army of needless fears that arouse harmful reactions.

From recent interesting experiments, described in this article, Dr. John B. Watson, New York psychologist, has pointed out how fear arises in our children and how we may endeavor to free them of its baneful effects.—*The Editor.*

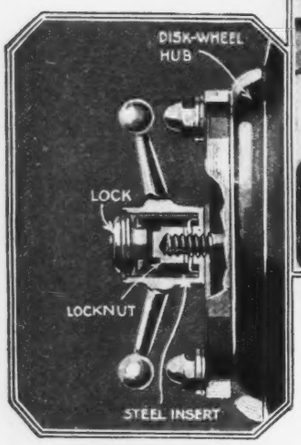
Policeman-Inventor Foils Auto Thieves

Ten New Tips for Your Car

EASY STARTING
When placed between carburetor and intake manifold, the hot wires of this electrical device vaporize the gasoline for instant starting

NEW ACCELERATOR
"Fluttering" of the throttle is eliminated by this cushion accelerator equipped with an air cylinder which operates over a piston

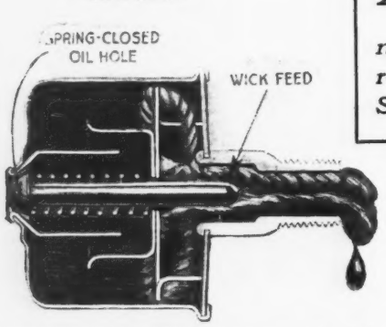
© K. & H.
AUTO THIEVES, BEWARE!—In inventing the safety device illustrated above, a noted police official has successfully matched his ingenuity against the craftiness of the automobile thief. The device is placed permanently on one of the front mudguards. To lock the car, the driver, before leaving, removes the round disk at the top, puts a red diamond-shaped disk in its place and locks it. This makes the engine inoperative and tampering with the device starts an alarm siren



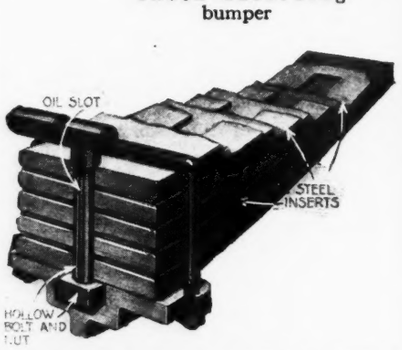
DISK-WHEEL LOCK
Simplicity and security are advantages of this lock for the auto disk-wheel

ABSORBS SHOCKS
Two heavy coilsprings are the feature of this shock-absorbing bumper

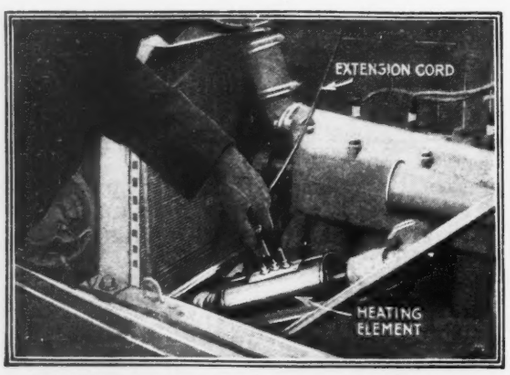
AS a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in POPULAR SCIENCE MONTHLY.



REPLACES GREASE-CUP—The oiling cup lubricates spring joints and other parts of the chassis. Wicking carries the oil

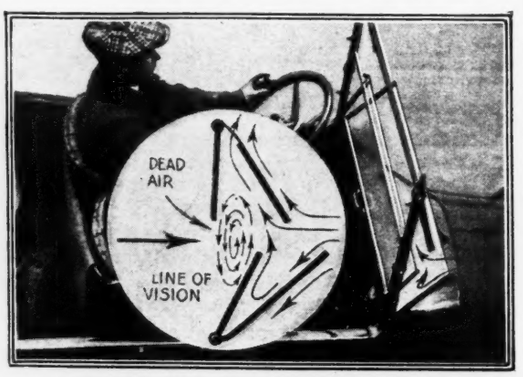


AUTOMATIC SPRING OILER—Through the hollow center bolt, oil is forced between the leaves of the automobile springs



ENGINE WON'T FREEZE—This heating element, attached to the Ford engine in place of the lower hose, keeps the water from freezing

Strips of spring steel hold this jiffy jumper in place while you repair your car



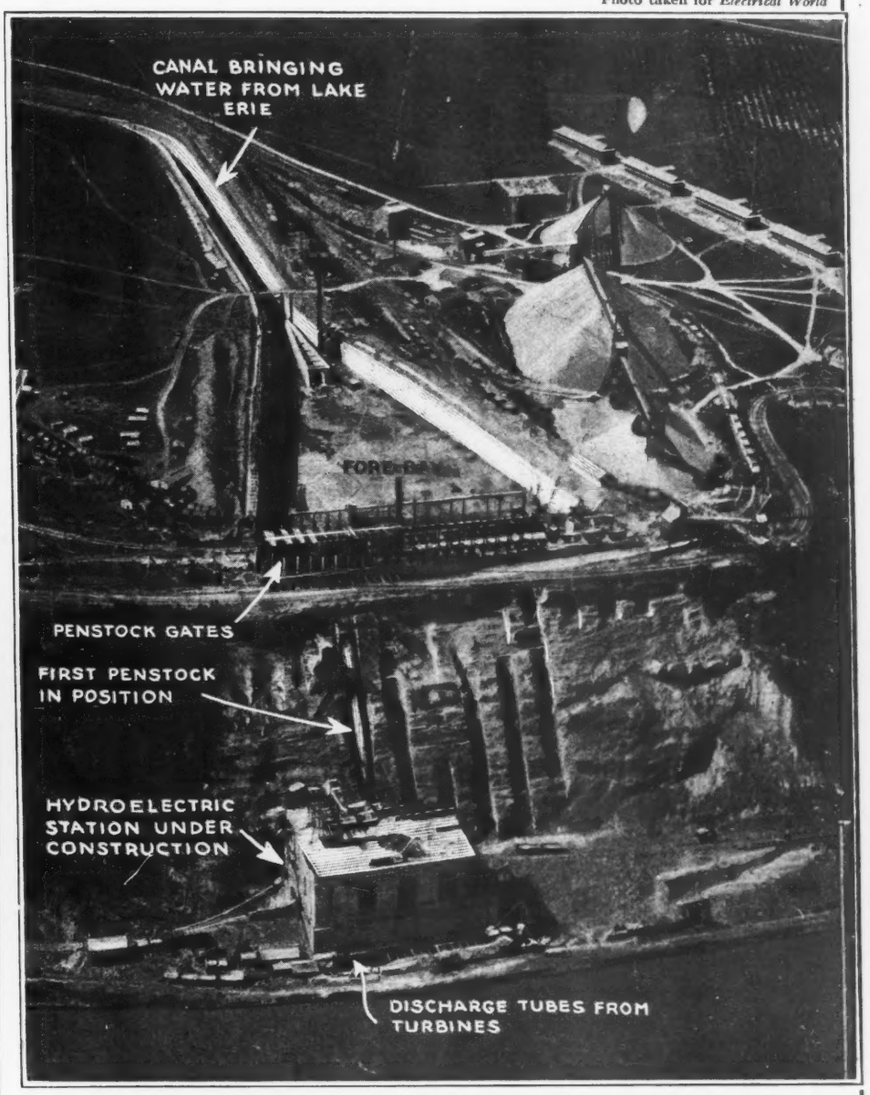
CLEAR VISION WINDSHIELD—By an arrangement of four panels the driver, while shielded, obtains a view unobstructed by glass

How Vast Hydroelectric Plant Operates—Viewed from Airplane

SIMPLY throwing an electric switch, E. C. Drury, premier of Ontario, recently set in motion the first generating unit of one of the greatest hydroelectric power systems in the world—the Canadian Hydroelectric Commission's development at Queenston, Ontario.

How the hydroelectric plant plans to utilize a 305-foot head of water is shown by this remarkable airplane view of the new Queenston station. In the background is the deep canal that brings water 13½ miles from Lake Erie. At the top of the cliff is a large triangular basin to provide ample water, a group of sluice-gates to control the flow, and the partially completed excavations for 10 almost vertical penstocks leading to the turbine wheels.

Photo taken for *Electrical World*



Electric Heater Protects Steel Trolley-Car Tires

AN electric heater similar in principle to the American rivet heaters has been perfected by a Swiss inventor for heating steel trolley-car tires preparatory to slipping them on the wheels.

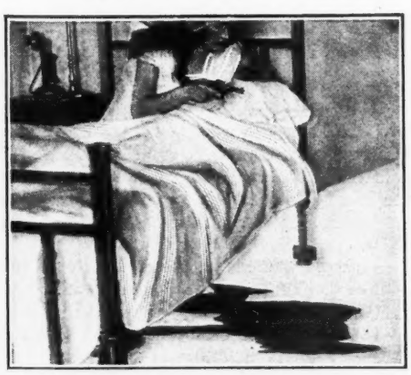
The heater consists of a base of channel section steel framing supporting a circular table of special heat-resisting compressed fiber, built up in sections, so that any section damaged by hot metal may be replaced.

Distortion of the tire, due to irregular heating, is prevented by this electric heater

The transformer is of the core type with a single coil. There are four external tappings, so that the number of turns can be varied. This permits a variation in the heat produced.

The inventor claims that the electric device prevents distortion due to irregular heating, and eliminates injurious effects on the steel from sulphur or phosphorus that is always found in coal.

Light Under Bed Scares Burglar—if He's There



IF you think there is a burglar hiding under your bed, switch on the new light placed beneath the mattress. This casts the burglar's shadow on the floor, that is, it will if it really is a burglar you hear and not a phantom of overtired nerves.

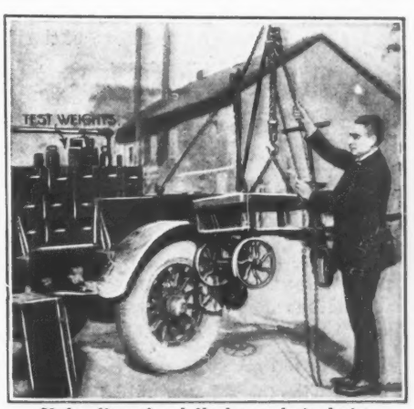
Convenient Fountain-Pen Tells the Date

BY looking at a calendar attached to the end of his fountain-pen, Charles F. Ashby learns the date. His invention consists of a slotted metal cap with a long roll of paper on the inside. On this paper are printed the days of the week and dates.

The strip is perforated, and through a second slot normally covered by a pivoted metal bar, the paper may be pulled forward until the proper date appears.

Motor Truck Is Equipped for Testing Scales

MOBILE equipment for accurate testing of heavy scales has been invented by E. J. Strobridge, of the Department of Weights and Measures of Alameda County, Calif. He has standardized a motor-truck at a definite weight, and equipped it with a "dolly" strong enough to make a one-ton test on each corner of the scales.

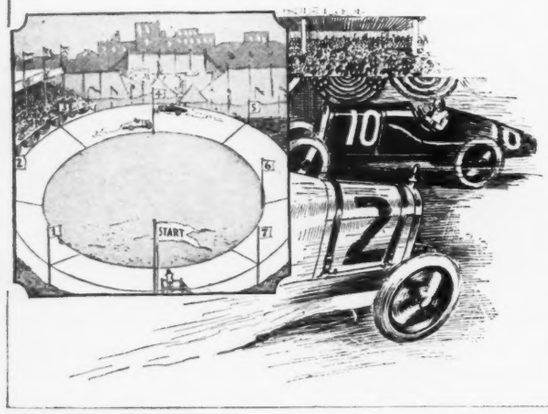


Unloading the dolly by a chain hoist

How Did the Race End?

Masters of Sam Loyd's Puzzles Win $25

They Met Seven Times in Six-Mile Grind



IN a six-mile race, after leaving the starting flag, the White and the Black racing cars, going in opposite directions on a mile track, met seven times.

Both cars went at their respective top speeds the entire distance. We snapshot the cars before the race was half over and the picture shows both cars at the four-furlong flag, directly opposite the starting line.

From that data we are expected to figure the distance by which the winner won.

December Prize-Winners and Puzzle Answers

FIRST PRIZE, Ten Dollars: Alexander Greenberg, N. Y. City.

SECOND PRIZE, Five Dollars: William Vaughan, Chicago, Ill.

The TEN ONE-DOLLAR PRIZES: Leland W. Riggs, Schenectady, N. Y.; Helen Lalin, Fromberg, Mont.; Elmer Brugmann, Cambridge, Mass.; G. Edwin White, N. Y. City; E. G. Weeks, Detroit, Mich.; Sarkes Tarzian, Philadelphia, Pa.; R. L. Hankinson, Dayton, Ohio; Robert R. Abbott, Cleveland, Ohio; Louis Kurz, Appleton, Wis.; Wm. Scott, Altoona, Pa.

For Honorable Mention list, see page 73.

A FIRST prize of $10 will be awarded for the best set of answers and analyses covering the three problems on this page; a second prize of $5 for the next best set; and ten prizes of $1 for the 10 next best sets.

Answers must be received not later than April 1, addressed to the Puzzle Editor, Popular Science Monthly, 225 West 39th St., New York, N. Y.

Answers to the April puzzles will appear in the June issue; the names of prize-winners in July.

Lighting the Boulevard

LET us call the distance between extreme poles, X yards. Then X divided by 440 equals X divided by 1320, plus 6. X proves to be 3960 yards.

Dividing 3960 by 440, we find that 10 poles would be required to plot the distance into 9 spaces of 440 yards each. Since there was a shortage of 3 poles, only 7 poles were available. The 7 poles, placed 660 yards apart, would stretch the length of the line.

When Cars Were Closest

CALL the time at which the cars will be nearest together on the line of the hypothenuse of the right angle triangle formed by their routes, O. Since the cars travel at uniform rates of speed, their approach and departure from O will be at the same rate. One hour before they reach O they will be the same distance apart as they will be one hour after passing O. At the start the cars are D miles apart.

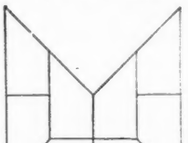
$$D = \sqrt{70^2 + 60^2} \qquad D = \sqrt{8500}$$

Traveling for X hours until again the distance between them is $\sqrt{8500}$. Then—

$$\sqrt{8500} = \sqrt{(60-32X)^2 + (70-24X)^2}$$ and X equals 4½ hours.

Dividing by 2, we get 2¼ hours as the elapsed time in arriving at O. In that 2¼ hours A, traveling from the north, advances 12 miles beyond the intersection of cross-roads, while B, from the west, advances 16 miles distant from the crossing. Thus their distances from the point of intersection form sides of a right triangle, the hypothenuse of which—the distance between them—is 20 miles.

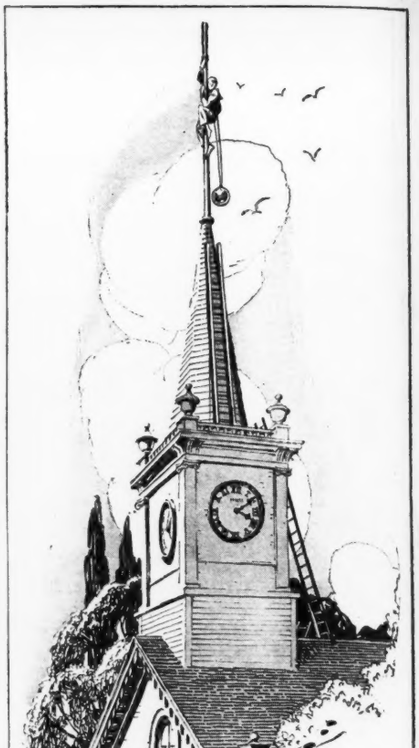
The Referee Settles It



THAT miter-shaped piece of land, being three quarters of a perfect square, is divided as shown, to produce the eight equal sections.

The Wrecker's Offer

A 25 per cent reduction in the first asking price reduced the difference between the buyer's and seller's terms by $250. Therefore the owner's first demand must have been $1000. Since the wrecker was willing to do business on a basis of $1500 less than the asking price, he must have demanded $500 above the value of the material.



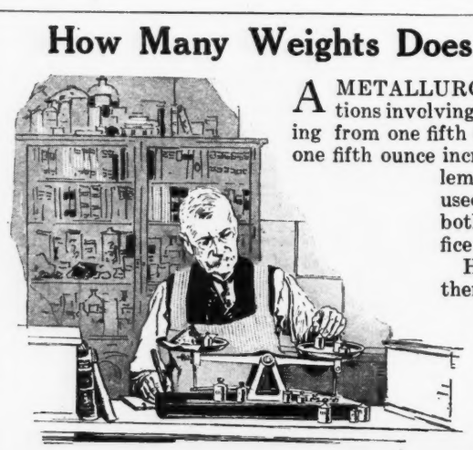
Time This Slipping Young Steeple Climber

A DRAMATIC incident in the life of a Long Island village provides this puzzle. A windstorm had removed a gilded ball from the flagpole of the new town hall, and the task of replacing it was by no means simple, for the upper part of the pole was of polished metal, defying a climber's grip.

Finally the townsfolk found a young jackie willing to undertake the job. Although the polished section of the pole was only 19 feet 8 inches in length, the young fellow's navigation of that distance was thrilling. The first section of the pole offered no difficulties, but when the climber struck the slippery part, his troubles began. He climbed in spurts of six feet in six minutes, and then relaxing, slipped back three feet in a jiffy. He progressed at that rate to the top.

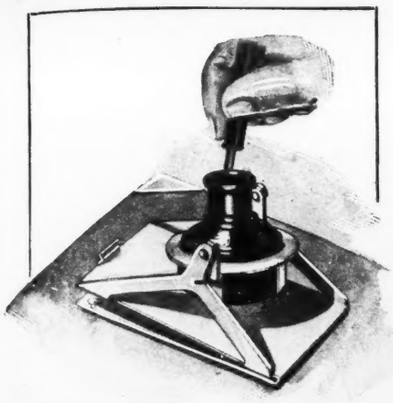
Our problem is to tell just how long it took him to go that 19 feet and 8 inches and perch on top of the pole.

How Many Weights Does This Man Need?



A METALLURGIST who was working out calculations involving group combinations of metal weighing from one fifth of an ounce up to eight ounces, in one fifth ounce increases, found it an interesting problem to figure out how few weights, used as weights and counterweights on both sides of his simple scales, would suffice to effect the necessary 40 weighings.

He first weighed one fifth ounce, then two fifth ounce, three fifth ounce, four fifth ounce, one ounce, and so on, up to eight ounces. The weighed metal itself is not to be employed as weights, so let us figure out the fewest possible number of actual weights that can be used to carry out his weighings.



Here's an Ink Bottle that Won't Spill

BY means of an invention of Roland Harding, of New York City, a mechanical draftsman may keep his ink bottle within reach even when he is drawing on a tilted board. A swinging ring support keeps the bottle upright, no matter at what angle the board may be clamped, allowing the quill to dip in the ink even when the bottle is nearly empty.

A wedge-shaped metal support holds the bottle in place on a sloping surface. This support is fastened to the drawing-board with four thumbtacks. By means of the rack at the left, the angle between the support and the table can be adjusted so that the bottle is always upright.

New Tongues for Old

SMALL hand mirrors and ivory tongue guides are helping foreigners twist their mouths into shape to speak English correctly. If, after attempting to imitate his instructor, the student can't make his tongue behave, that unruly member is prodded with an ivory stick, as shown in the illustration at the right

© Keystone

"OO-OO-OO"

A lip model over the instructor's mouth shows how to say it

ENGLISH AS SHE APPEARS

Looking into hand mirrors, the students observe their own attempts to imitate positions of the instructor's mouth as he forms the difficult vowel and consonant sounds

Every Thrilling Movie Film Is a Silver-Dollar Mine

THE silver dollar you are carrying in your pocket today may have been part of a Bill Hart thriller or a Mary Pickford romance.

Does that sound like "movie talk"? Then listen to the story of a modern "Forty-Niner"—A. S. O'Neil is his name—who discovered, not long ago, that every motion picture studio is a small silver-mine.

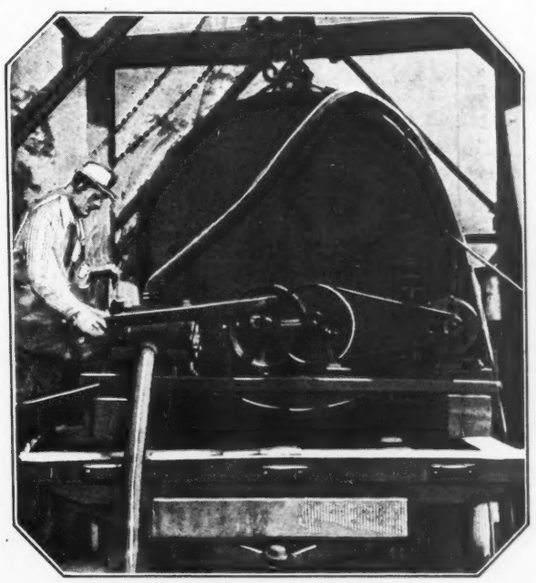
It proved to be a lucky strike. In a single year O'Neil has taken $315,000 worth of silver ingots from the slops of studios, recovering from the wash waters of the movie camps at Hollywood, Calif., more solid cash than many a big film producer makes on a smashing cinema production.

Fortunes Thrown Away!

Two years ago the film producers were dumping the stale hypo fixing baths from their darkrooms into the city sewers. Then came the twentieth century miner, with a business proposition that is yielding some studios as much as $3500 a month for what was formerly worthless.

The silver O'Neil salvages from sewage was once the vital element of motion-picture film. Film comes from a pulp of cotton made by a chemical process and treated with camphor, which is rolled into it under pressure. The makers apply to one side of the film a thin layer of gelatine, mixed with finely divided, colloidal silver bromide. When an exposure is made, the light striking the film changes the silver bromide into metallic silver.

When the film is developed, hypo is used to dissolve the excess silver bromide on the film. This process results in washing off into the hypo bath about half the silver salts originally held in the emulsion.



A TANK FULL OF RICHES

When a tank of hypo from a studio arrives at the plant of the modern "Forty-Niner," motor-driven siphons empty the precious "waste" into precipitating tanks

Processes through which waste movie hypo is magically turned into silver nuggets are illustrated above

The development of 1,000,000 feet of film leaves approximately 800 ounces of silver in the hypo. Immense tanks of hypo used by the studios have to be changed frequently because they become weakened by being saturated with silver salts. From these waste solutions Mr. O'Neil recovers 8000 ounces of pure silver a month.

According to Mr. O'Neil, 60,000 gallons of waste hypo contains on the average 1¼ tons of solid silver. Nine hundred and sixty gallons will produce a 40-pound ingot of silver, worth $240.

Salvaging the Precious Metal

Twice a month Mr. O'Neil hauls waste hypo from the various studios to his precipitating plant. As soon as tanks of hypo arrive at the plant, motor-driven siphons empty them into huge precipitating tanks, where the fluid is agitated with scrap iron and mercury. The iron replaces the silver in the salts, and the metal amalgamates with the mercury, slowly settling to the bottom of the tanks. The waste water is then dumped into the sewer. At the end of 10 days, when the bottoms of the vats are filled with black silver mud, the precipitate passes through a filtration process, and is then baked.

After the last particle of moisture has been baked out, this mud is melted with iron and sawdust in a furnace. The slag is then skimmed from the mass of molten metal, and the pure silver at the bottom of the crucible is finally poured into molds that turn out 40-pound ingots.

These are shipped from the world's most unique silver-mine to the government mint to be coined into dollars.

"AMERICA wastes 55,000,000 tons of cornstalks every year. Who will find a profitable way to convert their fiber into paper, to replace our failing pulp supply?"—*Dr. Merton S. Rice.*

© Ewing Galloway

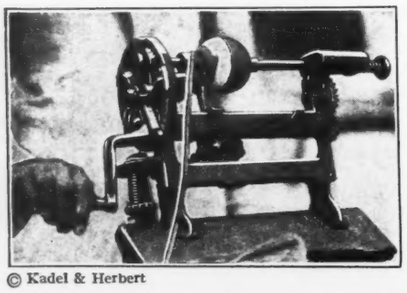
Ceylon School Kiddies Read Wooden Books

IN Ceylon school books are made of wood, and the children learn their lessons by heart, a page at a time. The schoolmaster paints the letters on short boards with thick waterproof paint. As soon as a pupil can copy and repeat from memory everything written on the board, he receives a new one.

Before the invention of printing a system somewhat similar was used in Europe for teaching the A B C's. The lessons were written on a thin sheet of wood, and over this two thin, transparent pieces of horn protected the letters from erasure. These slates were called "horn books."

Cuban Street-Venders Peel Oranges with Lathe

LATHES for peeling oranges are part of the business equipment of every fruit-vendor in Cuba. When you buy an orange, it is handed to you ready to eat. The



© Kadel & Herbert

peeler is simple in design, and unnecessarily rugged in construction. It is built along the lines of a small lathe.

The orange is gripped in a chuck, which holds by the pressure produced by the spring at the right. Turning over the hand wheel rotates this shaft very rapidly, and the orange skin is removed by a sharp U-shaped cutter held against the orange by set-screws.

Notice that the peel is removed in an unbroken strip, and that the pulp of the orange has not been punctured.

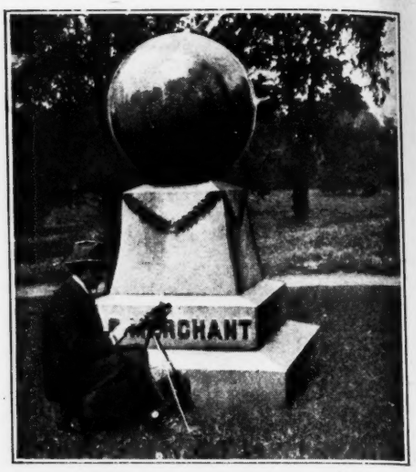
IF you want to attract the birds, plant red cedar, flowering dogwood, or Virginia creeper near your house. These furnish the birds with food and shelter.

Three Men and Crowbar Remove Her Necklace

WHEN a native African woman decides to remove her necklace, she calls three husky men and a crowbar. Her necklace consists of a strip of brass or iron

three inches high, and from 15 to 18 pounds in weight, welded about her neck.

While she kneels, cords are fastened from her necklace to a pole and crowbar. Three "huskies" then pull the bar.



Spooks! Tombstone Moves on Its Pedestal

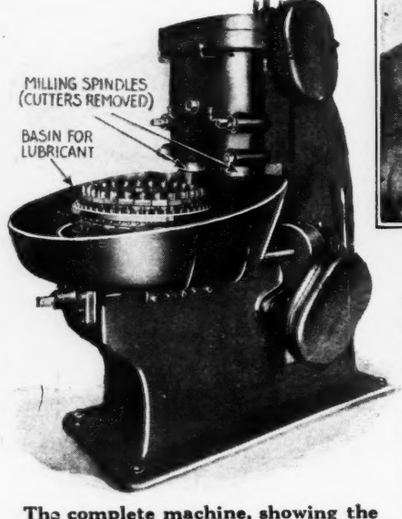
IS it a ghost? A spherical gravestone in a cemetery at Marion, Ohio, keeps revolving day by day, as if turned on its base by the hands of a "spook."

The monument, apparently solid and substantial, consists of a large polished sphere of granite supported on a marble base. But instead of resting, the sphere revolves very slowly. This movement, almost imperceptible, was discovered when a small unpolished section where the sphere originally rested on the base slowly crept into sight. The unpolished patch has now traveled around the circle.

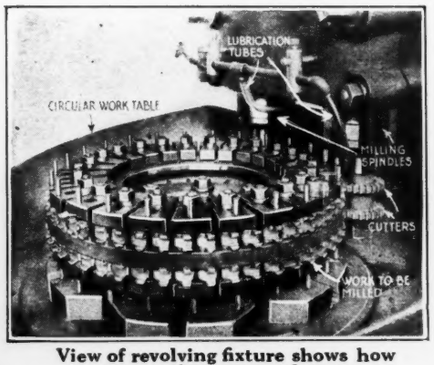
There is an obvious scientific explanation. One side of the granite sphere is protected by trees, while the other is exposed to the sun. In consequence, one side is heated every day, while the other is always cool. This uneven contraction and expansion causes the stone to revolve.

Milling Machine Finishes 240 Pieces an Hour

A MILLING machine that produces continuously, finishing 240 small pieces an hour, at a labor cost of $.0032 a piece, is the latest development in automatic machinery. For example, 100 rough gearshifter yoke forgings, to which figures refer, can be inserted in a circular fixture, and milled simultaneously.



The complete machine, showing the circular multiple "jig" and milling spindles

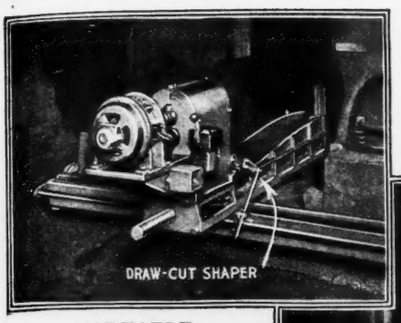


View of revolving fixture shows how it presents forgings to the cutters

The fixture revolves in front of the milling cutters at a table-feed rate of three inches a minute. The first cutter takes the rough cut, and the work moves on to the second cutter, which gives the finishing cut.

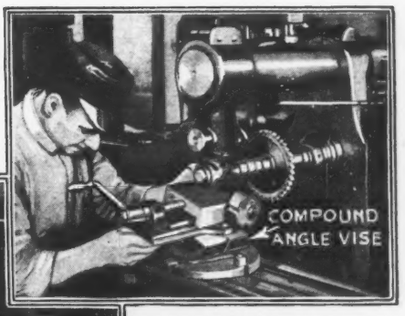
As the work revolves constantly, it presents a changing angle to the cutter, gaining the benefit of a shearing action.

Presto! Your Crankcase Completely Drilled



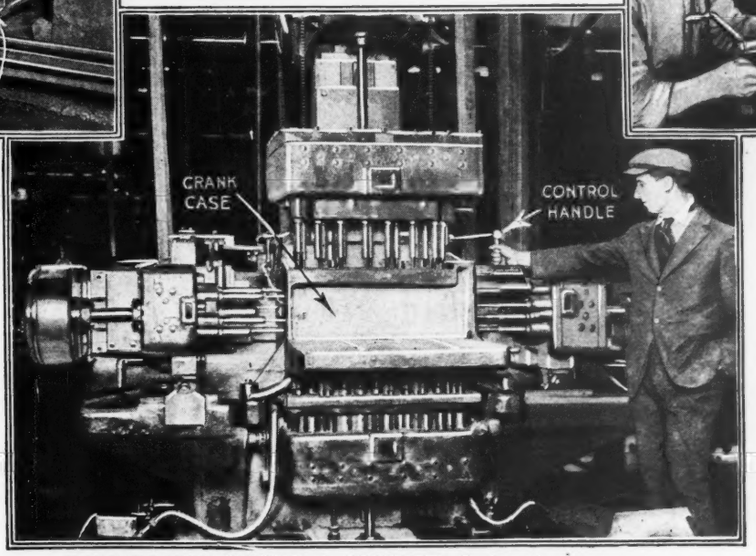
PORTABLE SHAPER

Although this draw-cut shaper is built strong enough for truing up drop-forged parts and heavy castings of large size, it is easily portable

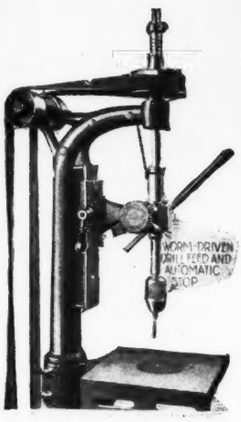


ANGLE VISE

With this compact vise an object can be held at almost any angle, as the device swivels 360 degrees horizontally and 100 degrees vertically

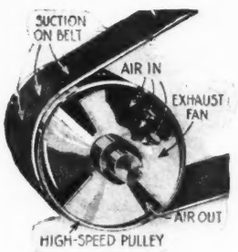


EIGHTY-TWO HOLES A MINUTE—In less than one minute this multiple drilling machine will drill 82 holes simultaneously in a four-cylinder crankcase. The machine takes the place of from six to 11 separate tools and results in a great saving of time, an enormous advantage where speedy mass production is essential

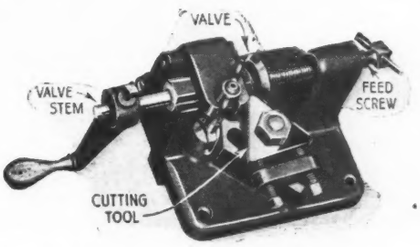


SAVES DRILLS

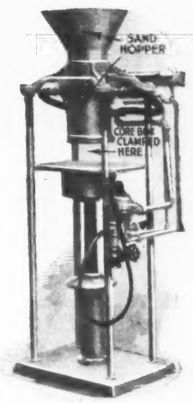
Drills less than 1/8 inch in diameter often break in the drill-press. The device illustrated above regulates the rate of feed, preventing breakage



SUCTION HOLDS BELT—The exhaust fan that is part of this high-speed pulley produces a vacuum inside the pulley. The suction gives the belt a firm grip

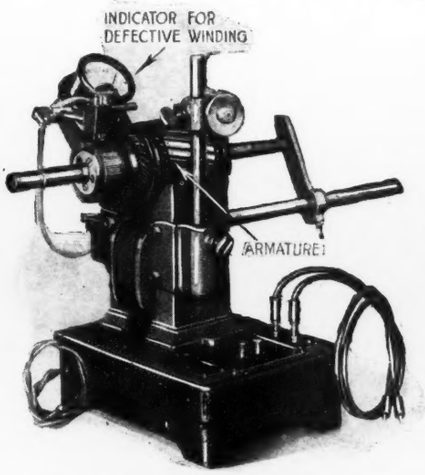


CUTS ANY ANGLES—This new valve-refacing machine has a triangular, removable cutting tool that may be set at any angle to conform with the shape of the valves



CORE-BLOWER

Manufacturers of small castings can speed their production with this pneumatic sand-core machine, which turns out even complicated cores at the rate of 180 an hour



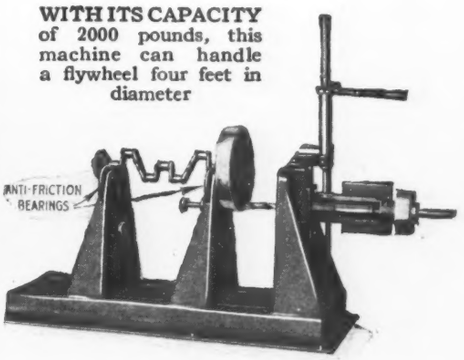
ARMATURE FAULTFINDER

The apparatus illustrated is used for testing armatures of motors or generators. It will locate a defective coil or commutator bar, open or grounded coils, and short circuits

CLEANS MOTOR PARTS

Ball bearings, roller bearings, gears, magnetos, and parts of motors or generators may be cleansed quickly and thoroughly in this washing machine

WITH ITS CAPACITY of 2000 pounds, this machine can handle a flywheel four feet in diameter

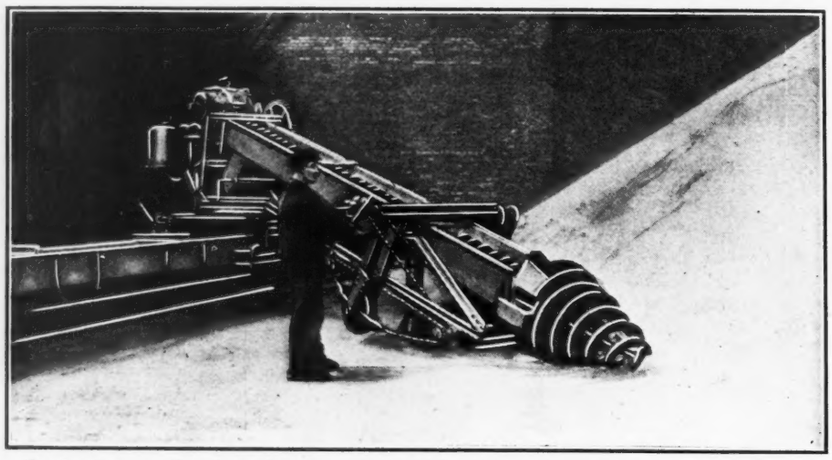


NEW BALANCING TOOL

Balancing and drilling flywheels with crankshaft attached is possible with the machine shown above. The flywheel is placed between the drill standard and the balancing standard

AS a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in POPULAR SCIENCE MONTHLY.

Self-Loading Screw Conveyor Handles Thirty Tons an Hour



Boring into a pile of earth, the screwhead breaks up lumps and carries the material to the screw conveyor. The motor driven mechanism swings on a pivot

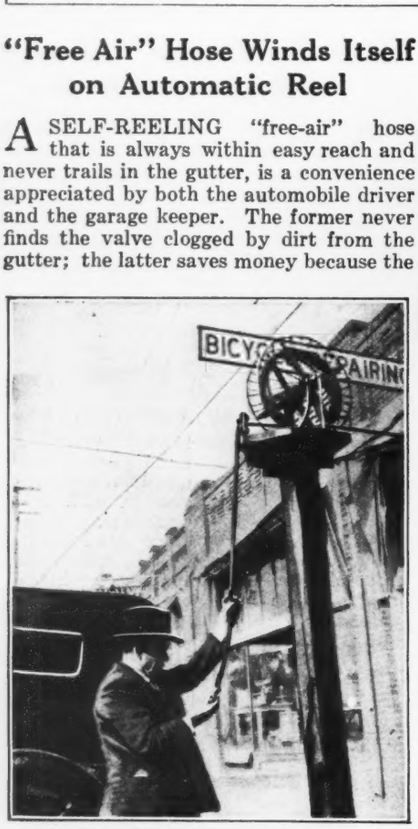
A PORTABLE screw conveyor, driven by an electric or gasoline motor, has recently been adopted for mechanical loading where only small volumes of material are handled. Because of the small amount of headroom required, the device is especially useful for indoor work.

An essential feature of the invention is the large screwhead that bores into the pile of material to be moved, breaks up all lumps, and prepares the earth for the conveyor. The screw conveyor, placed in an inclined position, is turned like the cutting head, by a motor at the upper end of the conveyor trough.

The lower end of the machine is mounted on wheels, and the entire mechanism swings around a movable pivot at the upper end of the conveyor trough. This arrangement makes it possible to reach a large section-shaped floor area with the loader. The capacity of the device is 30 tons an hour.

"Free Air" Hose Winds Itself on Automatic Reel

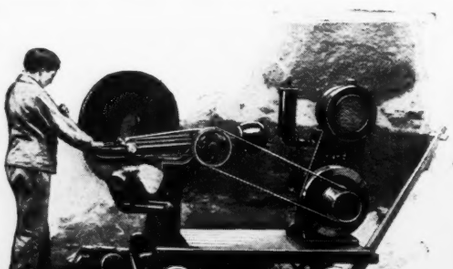
A SELF-REELING "free-air" hose that is always within easy reach and never trails in the gutter, is a convenience appreciated by both the automobile driver and the garage keeper. The former never finds the valve clogged by dirt from the gutter; the latter saves money because the hose is never accidentally cut by the wheels of passing trucks.



To fill his tires, the motorist unreels the hose, which rewinds itself when released

The installation is automatic. The hose is wound around the rim of the reel, which is mounted on top of an eight-foot post, and several turns of sash cord attached to a counterweight inside the hollow post are wound around the axle in the opposite direction. The airpipe runs to the core of the reel, which has a swivel joint in the bearing, and the hose is connected to a hole tapped through the opposite end of the core.

The counterweight is made light so that the hose can be easily pulled down to the tire, but this action raises the weight and wraps the cord further around the axle. When the hose is released, it is rewound by the falling weight.



Power-Driven Cordwood Saw

A POWER-DRIVEN circular saw for cutting cordwood, guaranteed to be foolproof, has recently been perfected. The billet to be sawed is placed in a V-shaped holder, and clamped by a lever held down by the operator's left hand. With his right hand he pulls the circular saw down onto the log. A counterbalancing weight makes the effort required very slight.

In the upright position, the saw is completely covered by a metal guard that rests on the top of the log. As the saw starts to cut, it moves downward, but the guard, held in contact with the log by a spring, stays in position. When the cut is complete and the saw is raised, the guard instantly snaps into position over the cutting edge.

The machine is mounted on rollers to facilitate transport. The weight, including motor and platform, is about 200 pounds.

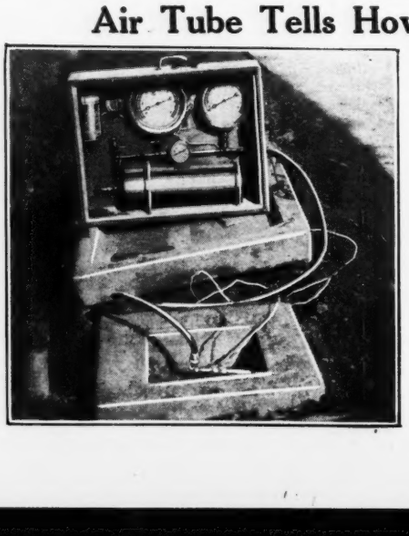
If You Kneel at Your Work This Pad May Help

HERE is a pad, invented by Edwin N. Kauffman, of Mahaffey, Pennsylvania, that makes it possible for workmen to kneel at their work in comfort. The pad is enclosed in a pocket of the canvas strip that encircles the leg. It is secured in place by elastic straps.

The pad is enclosed in canvas fastened about the knee by elastic straps

This knee pad is particularly designed for the use of miners and is so constructed that it is closed all around to keep out slack or fine coal. It can be easily removed.

Air Tube Tells How to Build Roadbeds



BY means of a compressed-air tube connected with a stone slab buried under a roadbed, traffic experts can find out what happens under a road as heavy trucks pass. The tube transmits the movements of the slab, through a giant-floating metal drum, to an indicator dial. The device was invented to find out how thick roadbeds should be built.

A very thick roadbed lightens the load on every square foot of the earth or road on which it rests, since the impact on the surface is distributed over a larger area than is the case with the thinner bed. On the other hand, thick roadbeds cost money. The purpose of the device is to determine how thin they may safely be built.

French Church in Ruins Yet the Bells Ring

IN the French village of Cléry on the Somme River, there is a church belfry without a church beneath it. All that remains of the building are two shapeless piles

In the ruins, three bells hanging on a beam summon the villagers to service

of masonry rising a few feet above piles of shattered stone.

Although the church was completely destroyed by artillery fire, the people of the village still use it for services. They have begun the reconstruction from the top down. Even before the ground was cleared for new foundations, the three church bells were salvaged from the ruins and hung on a beam between the only parts of the church that were still high enough to lift the bells from the ground. Now, though the villagers must still worship in the open air, they are called to mass by the familiar chimes hung by their ancestors in the eighteenth century.

Merchants Sweep Walks with Vacuum Cleaner

RETAIL merchants in the Middle West are now using vacuum cleaners to sweep the sidewalks in front of their stores. They have discovered that the ordinary cleaner will take up the dirt from the sidewalk as neatly as it will clean linoleum or a bare floor indoors. At the same time it

Why not? A vacuum cleaner sweeps a sidewalk as clean as it does a floor

saves pedestrians the annoyance of dodging clouds of dust raised by the old-fashioned broom.

With storekeepers on both sides of a street using this method, the amount of dust and trash floating in the air is materially lessened. The cleaner, of course, actually removes the dust instead of merely stirring it up into the air again.

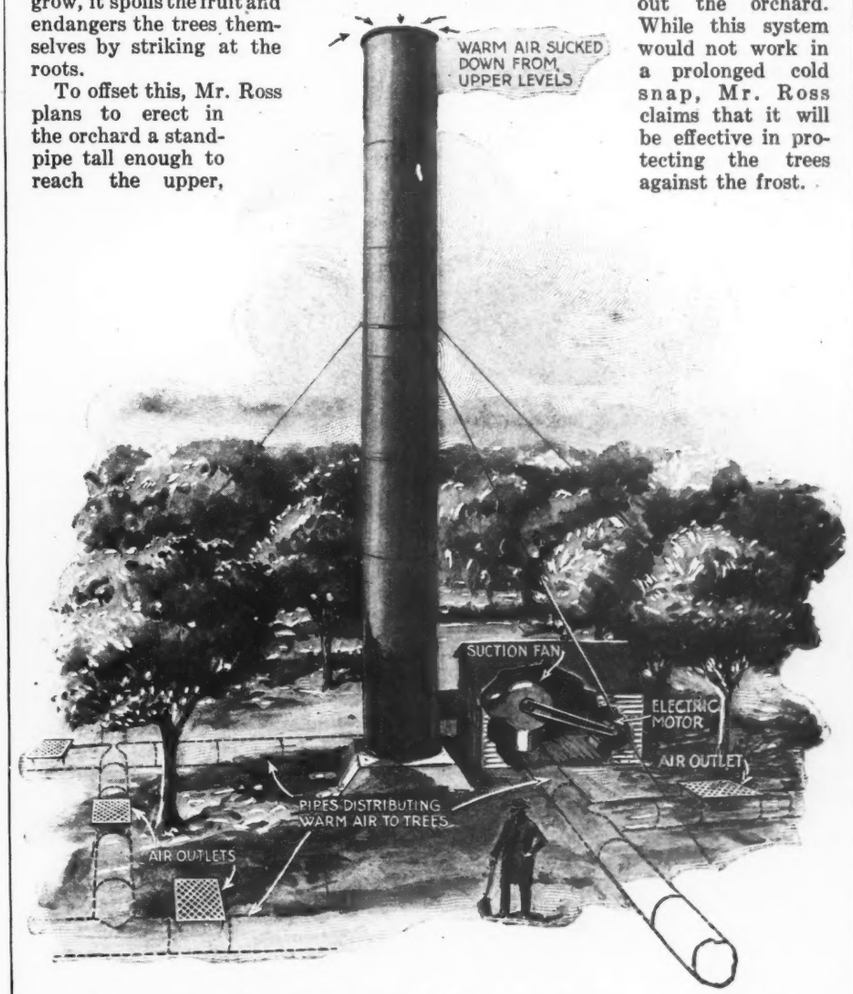
THE last Cornish tin-mine has closed down. Falling prices of the metal have stopped the oldest industry in Great Britain.

Rancher Taps Upper Air to Warm Orchard

TAPPING the upper air for heat is the novel scheme originated by William L. Ross, a rancher of Portersville, Calif., to keep an orchard warm and guard against damage by frosts without the use of stoves. Cold air, which is relatively heavy, tends to sink into valleys in mild weather. As it collects in the bottom levels where fruit trees grow, it spoils the fruit and endangers the trees themselves by striking at the roots.

To offset this, Mr. Ross plans to erect in the orchard a standpipe tall enough to reach the upper, warmer levels of the atmosphere. From the bottom of this stack pipes will radiate underground and terminate in radiators set flush in the earth near each tree.

On frosty nights a forceful suction fan driven by an electric motor will pull down warm air from above, and distribute it under the trees throughout the orchard. While this system would not work in a prolonged cold snap, Mr. Ross claims that it will be effective in protecting the trees against the frost.



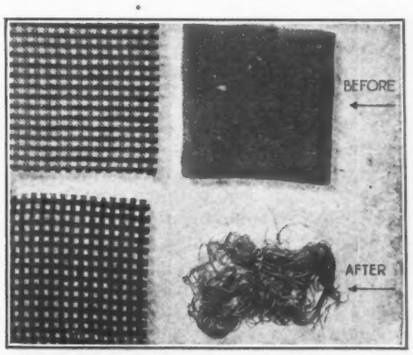
To prevent the orchard from catching cold on frosty nights, a suction fan pulls down warm air from higher levels and distributes it to radiators close to the trees

You Can Spot Cloth Shams at Home

YOU may be getting mercerized cotton and paying for linen. That "all woolen" suit may be adulterated with cotton—how can the consumer tell? Very easily, and by simple tests recommended by the United States Department of Agriculture.

A mixture of cotton and silk is spotted by boiling a sample of the cloth in a pint of water, containing from one to two tablespoons of household lye or caustic potash, for a period of fifteen minutes. The lye or potash will dissolve the silk fibers, leaving the cotton untouched. If anything is left after "wool" is placed in lye, you can be sure it is not wool, but cotton. The sample is shoddy.

The price that pure linen is commanding offers a temptation for its adulteration with mercerized cotton, the luster of the latter harmonizing with that of the more expensive material. Unravel lengthwise and crosswise threads for examination. Cotton fibers are short, dull, and fuzzy; linen fibers are long, fine, stiff, and lustrous. Similarly, boiling and laundering a

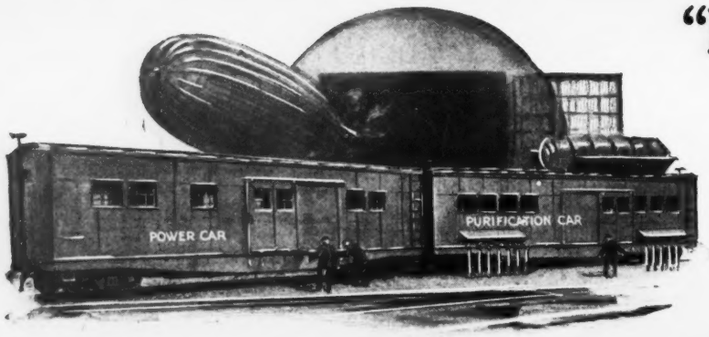


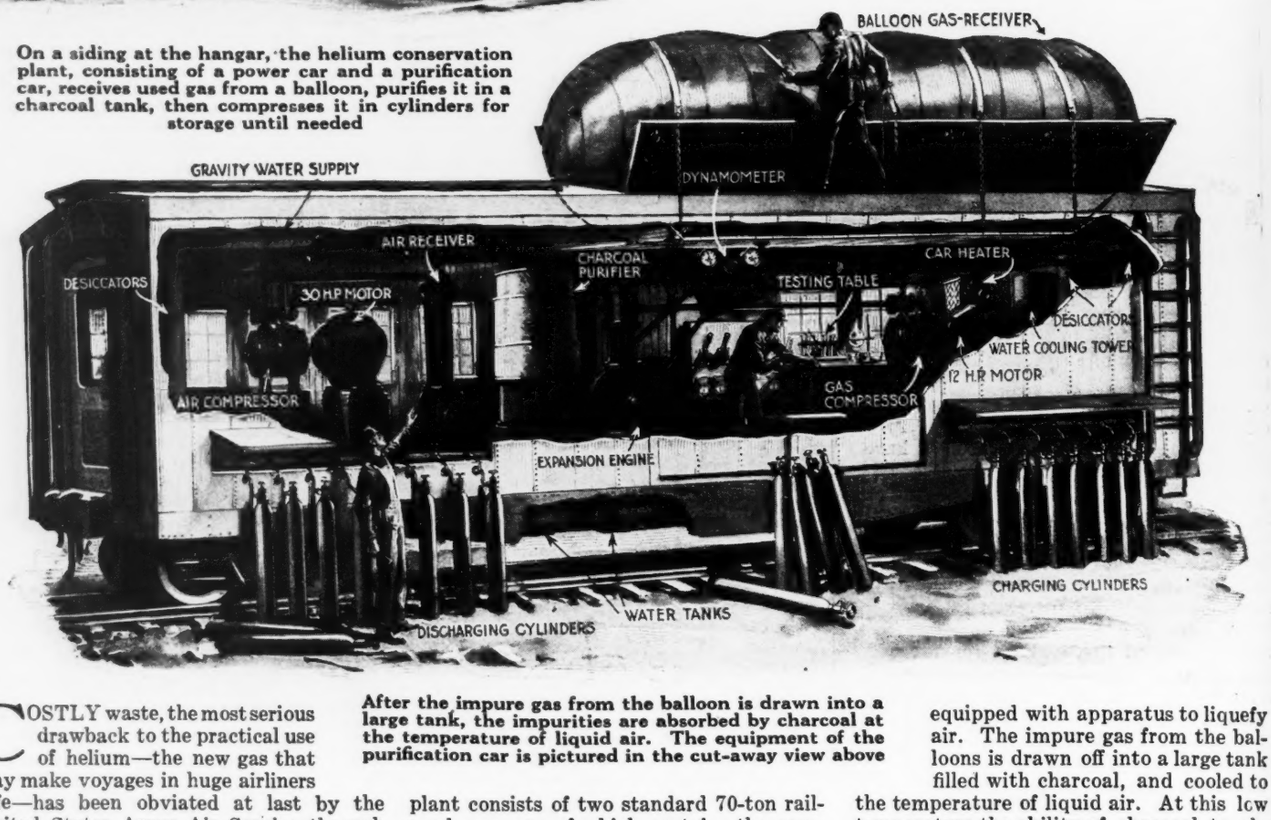
Left—Cotton silk is only cotton after boiling
Right—Cotton fibers from "linen"

sample of the material will quickly reveal the shams of manufacture.

"Mother Train" Repurifies Airship's Helium Supply

Army Invents Traveling Purification Plant to Conserve Priceless Gas for Dirigibles





On a siding at the hangar, the helium conservation plant, consisting of a power car and a purification car, receives used gas from a balloon, purifies it in a charcoal tank, then compresses it in cylinders for storage until needed

After the impure gas from the balloon is drawn into a large tank, the impurities are absorbed by charcoal at the temperature of liquid air. The equipment of the purification car is pictured in the cut-away view above

COSTLY waste, the most serious drawback to the practical use of helium—the new gas that may make voyages in huge airliners safe—has been obviated at last by the United States Army Air Service through the invention of a mobile gas purification plant carried in railroad cars.

Conservation of the precious supply of this gas, of which Uncle Sam has a virtual monopoly, and which is so limited in quantity that it must be used over and over again, if it is to be practical, can now be accomplished.

That helium has sufficient lifting capacity for balloon service was conclusively demonstrated recently when the semi-rigid dirigible C-7, starting from Langley Field, Va., made three successful flights, each of an hour's duration. The fact that helium cannot burn or explode, of course means an enormous gain in safety, and promotes the building of huge passenger airliners.

Balloons "Bled" of Gas

The C-7, like any other balloon, has to be "bled" of about 5000 cubic feet of expensive helium gas a day, and pure gas has to be added to bring the lift up to the required standard. Without the services of a repurification plant, this gas would be wasted.

But under the new plan, instead of allowing this helium to escape into the air, it will be compressed on the spot by an auto truck compressor, stored in gas cylinders, and carried back to the railroad purification plant. Here it will be repurified, and returned for use, 97 per cent pure. The plant consists of two standard 70-ton railroad cars, one of which contains the gasoline-electric power plant and the other the purification plant with its compressors.

The power car houses a 120-horsepower gasoline engine directly connected with a direct current electric generator. A duplicate motor is provided in case alternating current can be obtained from local sources. The remainder of the car is occupied by living quarters for the crew, gasoline and oil tanks, office room, and tool supply bins.

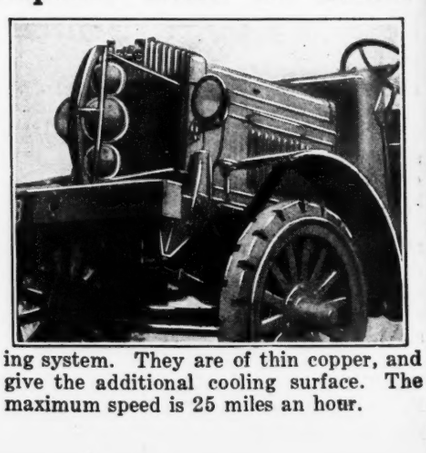
Since very low temperatures are required to purify helium, the purification car is equipped with apparatus to liquefy air. The impure gas from the balloons is drawn off into a large tank filled with charcoal, and cooled to the temperature of liquid air. At this low temperature the ability of charcoal to absorb gaseous impurities is increased, and it absorbs a large proportion of the nitrogen with which the helium is contaminated.

This process is repeated until a sample of helium examined at the testing table is found to be 97 per cent pure. The gas is then passed through drying cylinders to remove any trace of water vapor, and pumped through a gas-compressor, attached to a manifold charging at a pressure of 1800 pounds to the square inch machine, by which cylinders are filled with purified gas.

Low-Geared Truck Conquers Mud or Snow

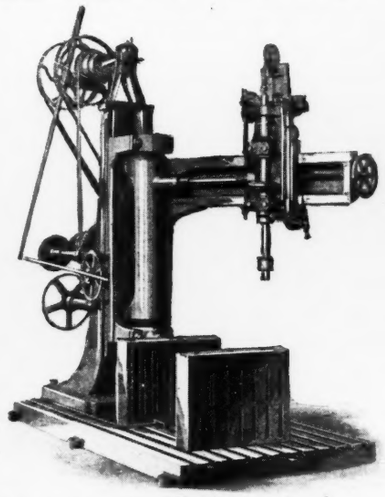
A NEWLY designed motor-truck that can be geared down to the snail-like speed of one mile in seven hours, or 12 feet a minute, never balks at mud or snow. To make such a low speed possible, the truck has a nine-speed transmission, built by placing two three-speed transmissions in tandem. When the low gear on both transmissions is engaged, the total ratio between the engine and the rear wheels is 150 to 1—that is, the wheels turn once for 150 revolutions of the motor. The power of the engine is increased correspondingly, and the speed is so slow that the wheels will not spin in mud or snow.

To provide ample cooling for very slow, hard pulling, three balls at the front of the radiator can be cut into the water circulating system. They are of thin copper, and give the additional cooling surface. The maximum speed is 25 miles an hour.



Drill, Half a Century Old, Still at Work

AFTER 55 years of uninterrupted service, an old-fashioned radial drill, purchased from an English firm in 1867 is still on duty in a shop in Winchendon, Mass. Except that it is somewhat light for



© *American Machinist*

This old timer has been drilling holes for 55 years and is still going strong

heavy work, the drill, even today, would be considered an excellent example of machine design. Within its capacity it will drill holes as well, although not quite as quickly, as any modern tool of its type.

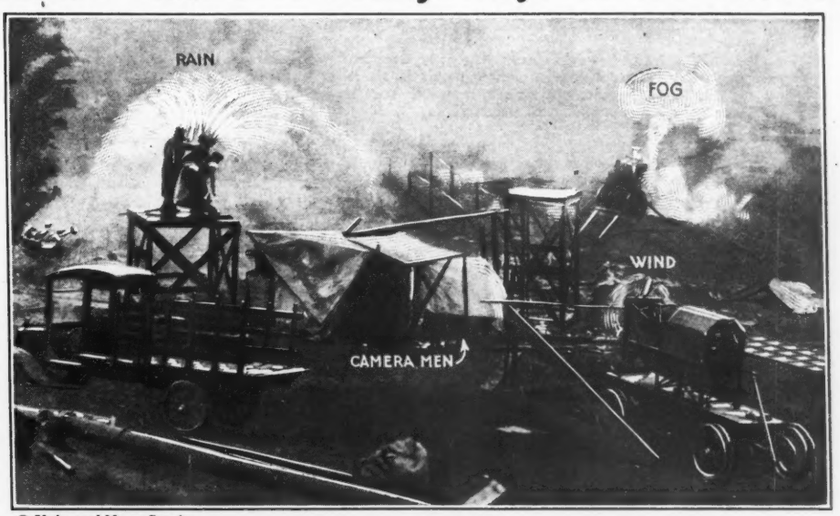
The old drill embodies many "modern" features, such as the power-driven elevating screw for moving the radial arm on the column, but it is not a "universal" machine and only drills holes parallel with column.

Has Your Motor-Car a Bureau Drawer?

"BUREAU drawers," and a convenient place to stow a pair of suitcases are two of the latest refinements of a custom-built touring-car of recent construction. With additional luggage space in back of the front seat, tourists no longer need choose between two evils—suitcases lying on the floor or dusty clothes resulting from carrying cases on the runningboard.

Two specially made suitcases fit into a recess behind the front seat. Above them, just below the top of the seat, are the two drawers, fastened with a cylinder lock.

Here's Secret of Rainy Days in the Movies



© Universal News Service

"FOGGY days" in motion-pictures are produced by three machines—a wind-maker, a smoke machine, and a hose. All are mounted on trucks so that they may be rushed from one part of the "lot" to the other, as the film story may demand.

The wind machine consists of a light auto engine geared to an airplane propeller. With graduated speed, the propeller can produce anything from a gentle breeze to a 40-mile tropical hurricane.

The "fog" is a white, non-irritating chemical smoke emitted by a device that looks like a fire-engine, equipped with valve controls that are used to prevent the fog from becoming dense enough to spoil a picture.

Rain is produced by directing a finely divided stream of water from a hose so that it will be caught by blasts of air from the wind machine and carried down upon the helpless actors, who are blinded, buffetted, and soaked as thoroughly as they would be by the force of a natural storm.

Star Puzzle-Solvers

THE following Sam Loyd puzzle fans deserve special commendation for their solutions to the brain twisters that appeared in the December issue. Correct answers and names of prize-winners in this contest will be found on Page 66.

HONORABLE MENTION

Earl Bailey, Ardmore, Okla.; C. Q. Beckwith, Ithaca, N. Y.; I. R. Holder, Farmington, Me.; W. C. Rogers, St. Louis, Mo.; H. G. Taylor, San Antonio, Tex.; Frank H. Broome, Jersey City Heights, N. J.; Harold L. Kerr, Brooklyn, N. Y.; H. G. Van Deusen, Oneonta, N. Y.; J. P. Ballantine, Ann Arbor, Mich.; Margaret Kelly, Albany, N. Y.; Walter E. Bracher, Marquette, Mich.; Enlan Olson, Wainwright, Alta.; Lieut. T. M. Crawford, Camp Benning, Ga.; Louis S. Hill, Detroit, Mich.; A. E. Mueller, Mayville, Wis.; John M. Michener, Wichita, Kans.; Laurence W. Davis, Gainesville, Fla.; N. H. Kingsley, La Farge, Wis.; John Liden, Brookline, Mass.; Caroline Otis, Davenport, Iowa; Walter T. Gordon, Springfield, Mass.; H. C. Hawley, Herington, Kans.; Jerry V. Matejka, Ft. Sam Houston, Texas; F. W. French, Lansing, Mich.

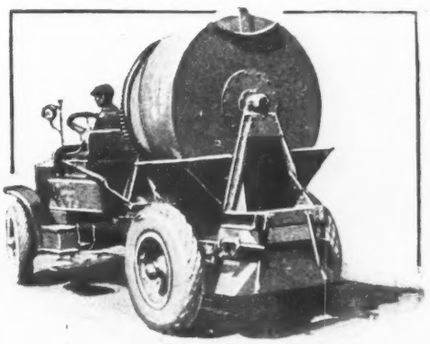
A. G. Hoppe, Milwaukee, Wis.; Theo. A. Hunter, Iowa City, Iowa; Shirley B. Rosenbloom, Brooklyn, N. Y.; Claude Ketchum, Lansing, Mich.; C. G. Pinney, Topeka, Kans.; Harold R. Henderson, Vancouver, B. C.; Ervin McKinley, Pearl Harbor, T. H.; Jos. A. Sjogren, New Haven, Conn.; Archie E. Rush, New Florence, Pa.; Walter E. Lorence, Golden, Colo.; L. G. Weber, New Orleans, La.; Alfred W. Leek, Flushing, N. Y.; Ralph W. Ball, Urbana, Ill.; James W. Easton, London, Ont.; Edgar G. Graban, Charleston, W. Va.; Ross D. Hildebrant, Howell, Mich.; S. E. Hallabaugh, Jr., Centerville, La.; M. R. Ford, Phelps, N. Y.; Samuel Wilkourtz, N. Y. City; H. G. Pertz, Highland Park, Ill.

Edmund C. Lynch, Sharon Hill, Penn.; W. B. Newell, Enid, Okla.; Chas. Landshof, Jersey City, N. J.; Addie Vosburgh, Oakland, Cal.; Chas. A. Morgan, Clarksburg, W. Va.; Lloyd L. Garey, Hackettstown, N. J.; R. A. Snowball, Jr., Montreal, Can.; Orville J. Grisler, Denver, Colo.; C. S. Crawford, Gretna, La.; J. J. English, Port of Spain, Trinidad; P. W. Tunberlake, West Point, N. Y.; G. V. Joubert, Savannah, Ga.; Mrs. J. D. Thomson, Aubrey, Ark.; W. D. Scott, Seattle, Wash.; Ruth Wheelock, Ann Arbor, Mich.; Albert Shelton, Cherokee, Iowa; Dick Davies, Minneapolis, Minn.; H. L. Whitney, Fostoria, O.

B. Fox, N.Y.C.; L. R. Stillman, Imperial, Cal.

This Truck Mixes Concrete on the Way to Work

A CONCRETE-MIXER mounted on a motor-truck chassis in place of the truck body is an interesting development by a Middle Western manufacturer. The



Concrete is mixed in the rotary drum driven by the truck motor

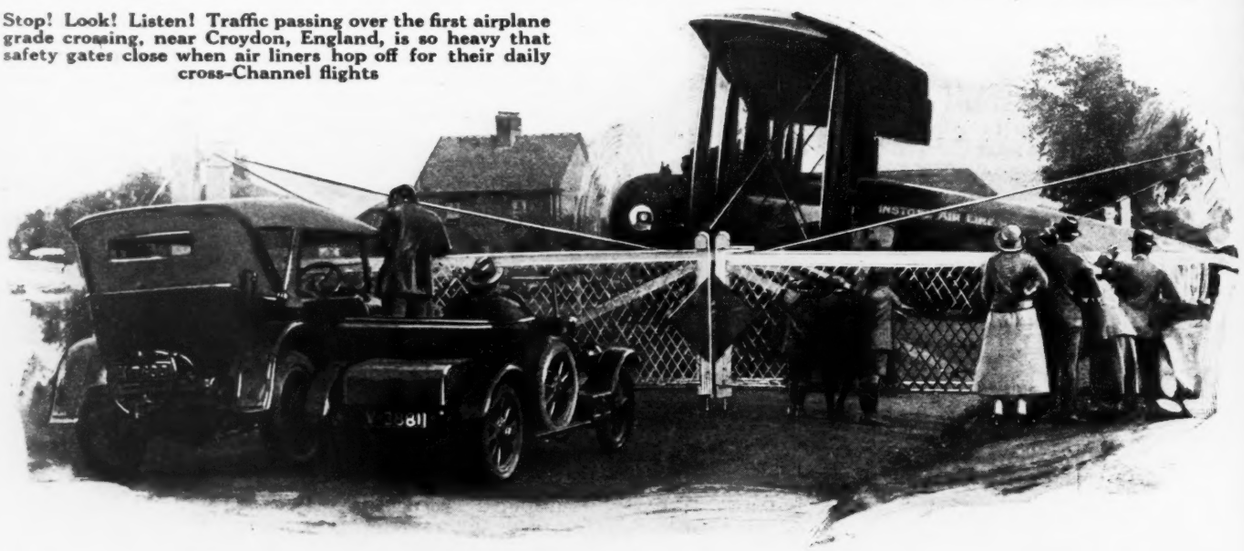
ordinary batch body with its hoist is replaced by a specially constructed frame fastening on to the chassis and supporting a rotably mounted concrete mixing-drum. Power to operate the drum is derived from the truck motor through a power take-off.

The charge is put in the drum from measuring-bins at the road-builder's yard, and the batch is mixed while the truck is on the way to the place where construction is going on. Mixing is usually completed on the final stretch, just before discharging, but the drum may be rotated at any truck speed either forward or reverse or when standing still.

The mixed batch of concrete is discharged by gravity into a chute delivering the material to the rear of the truck and as the truck moves forward the chute spreads the concrete so that only a small amount of hand spreading is necessary.

Look Out for the Airplane! Safety Gates Guard Grade Crossings

Stop! Look! Listen! Traffic passing over the first airplane grade crossing, near Croydon, England, is so heavy that safety gates close when air liners hop off for their daily cross-Channel flights



A motor runs the three-bladed knife

Revolving Butcher Knife Does Five Men's Work

A REVOLVING butcher knife constructed on the principle of a dentist's electric drill, has been invented by Hans Cantieni, of Switzerland, who hopes that by this means a single butcher may be able to skin an animal as fast as four or five men now do this work in an American slaughter house.

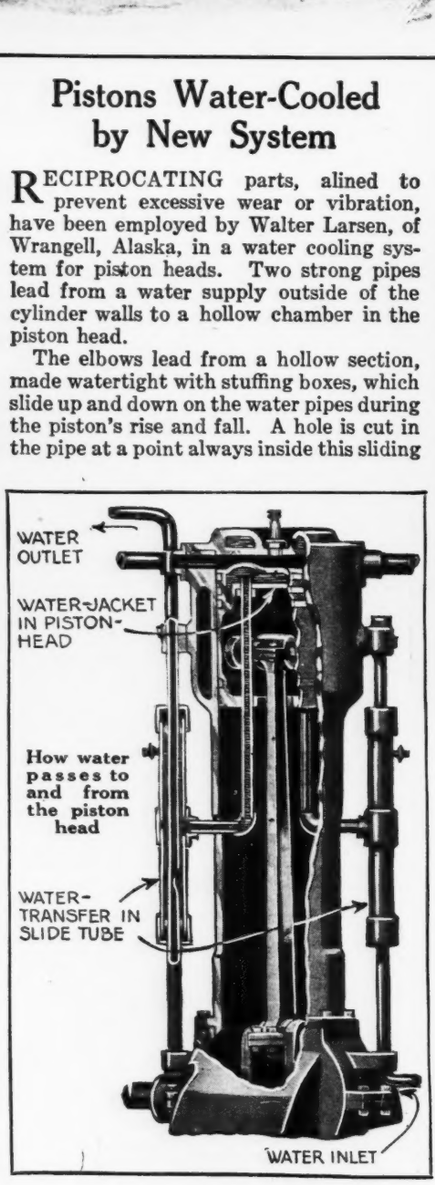
Power is derived from an electric motor hung from the ceiling, which is provided with a long flexible shaft of braided cotton cable enclosed in a spring guard. This turns a three-bladed knife shaped like a clover leaf. Each blade is ground into three rounded knobs to give the maximum shearing action.

The guard is oval-shaped, and bevelled so that the butcher can force it quickly between the hide and the flesh without the slightest possibility of cutting the leather or injuring the meat.

Pistons Water-Cooled by New System

RECIPROCATING parts, alined to prevent excessive wear or vibration, have been employed by Walter Larsen, of Wrangell, Alaska, in a water cooling system for piston heads. Two strong pipes lead from a water supply outside of the cylinder walls to a hollow chamber in the piston head.

The elbows lead from a hollow section, made watertight with stuffing boxes, which slide up and down on the water pipes during the piston's rise and fall. A hole is cut in the pipe at a point always inside this sliding


WATER OUTLET
WATER-JACKET IN PISTON-HEAD
How water passes to and from the piston head
WATER-TRANSFER IN SLIDE TUBE
WATER INLET

section, and the water circulates up one elbow, through the piston head, and down on the other side.

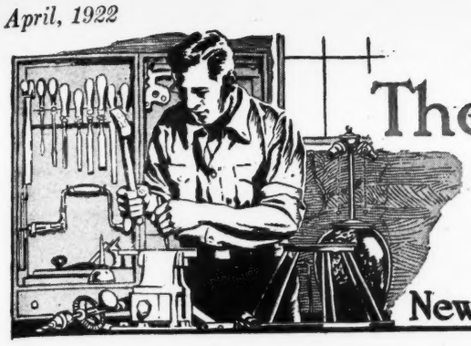
The outlet pipe in the piston is higher than the inlet, so that the head is always filled with water.

Grass Suspension Bridge Spans African River

BY bridging a stream nearly 100 feet wide with grass and reeds, the native Cameroons of West Africa have demonstrated that they are awake to the advantages of the suspension bridge for long spans. In one of their structures recently discovered there is not a bit of iron, wood, or even what a civilized man would call rope.

The braided grass and fiber ropes were wrapped into bundles to give strength and were hung across the river in four spans. Two of these are directly over the footway, and support vertical stresses. The natives, however, were engineers enough to know they must also provide for side-sway and wind pressure, and so the two other spans were hung at some distance on each side of the bridge. Diagonal rope guys hold the bridge steady horizontally. The footway is made of a mattress of most ingeniously woven reeds.

The bridge is on a main caravan route, and saves many miles to travelers, for it crosses a river that has few fords.



The Home Workshop

New and Useful Things for the Practical Man to Make

How to Build a Monoplane Glider

By William J. Beach

The New Sport of Soaring

GLIDING promises to be a popular sport. As told in several recent numbers of POPULAR SCIENCE MONTHLY, the possibilities of gliding have appealed strongly to American sportsmanship, not alone because soaring flights are the result of the pure skill of the designer and aviator, but also because of the prospect of developing the glider into a new type of very light airplane, propelled by a small engine, for pleasure purposes—a canoe of the air.

TO construct the glider illustrated in the accompanying drawings, the first thing to do is to make a right- and left-hand form on which to assemble the ribs. This may be done by cutting two solid ribs to the required curve and securing them to a wide board, after which sections are cut out of these rib forms, as shown in Fig. 19, to allow the veneer cross pieces to drop into their proper places. The ribs will readily bend to the form and retain their curve after the various parts are glued and fastened together with brads.

When the required number of ribs has been prepared, the I-beams are the next item to be considered. They consist of three boards, one on edge, with the others secured flatwise on the top and bottom, as in Figs. 4, 10, 11, and 12. The center board should be at least ⅞ in. thick and beveled at both edges to allow the top and bottom boards to assume an angle, as in Fig. 5. The three boards are glued and doweled at uniform intervals of not more than 9 in. and are then shaped to fit the inside of the ribs at their respective stations.

Assembling the Ribs

Before gluing and bradding the ribs in position along the beams, the various reenforcing blocks and beam brace lugs—Figs. 16 and 17—should be fastened in the beam webs.

Reference to Fig. 1 shows that extra substantial ribs are located at the roots of the wings, immediately over the vertical and diagonal struts, and also at the inner ends of the ailerons.

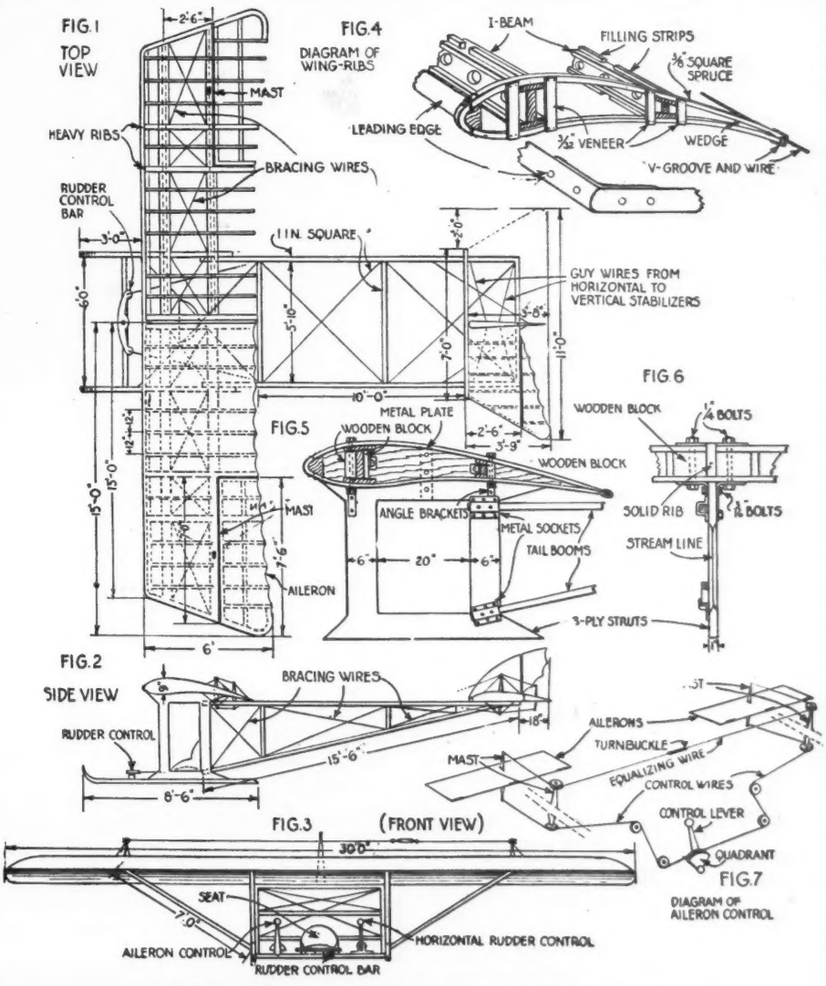
After the ribs and wing tips are secured in position, the beams are braced as in Fig. 1 with stout steel wire. Automobile spokes are used for turnbuckles, as shown in Fig. 13, the cables being secured to the lugs as in Figs. 16 and 17 by the method shown in Fig. 18. Substantially the same joint may be made as shown at the bottom of Fig. 13, by using a wire-wound thimble, the whole being soldered with a non-rusting paste. The simplicity of the joint in Fig. 18 is so marked, however, that it may well be used throughout the construction wherever possible.

The trailing ends of the ribs where the ailerons are located may now be cut off and discarded and those of the remaining ribs connected with a steel wire stretched along shallow V grooves as in Fig. 4. The wire is retained in the groove by tacking a narrow strip of thin metal, preferably copper, around the end of the ribs.

The ailerons are made in much the same manner as the wings, except that there is no need for the beams to be of I construction. Each aileron should be provided with three hinges.

After the two wings and ailerons are completed, the wings may be joined together as in Figs. 11 and 12. Wooden blocks are placed on each side of the vertical members of the I-beam under the plates. Staggered holes are drilled for ¼-in. bolts.

The tail unit may now be made. Its construction is clearly shown in Figs. 8 and 9. No explanation is required, since the construction is very similar to that of the wings and ailerons.



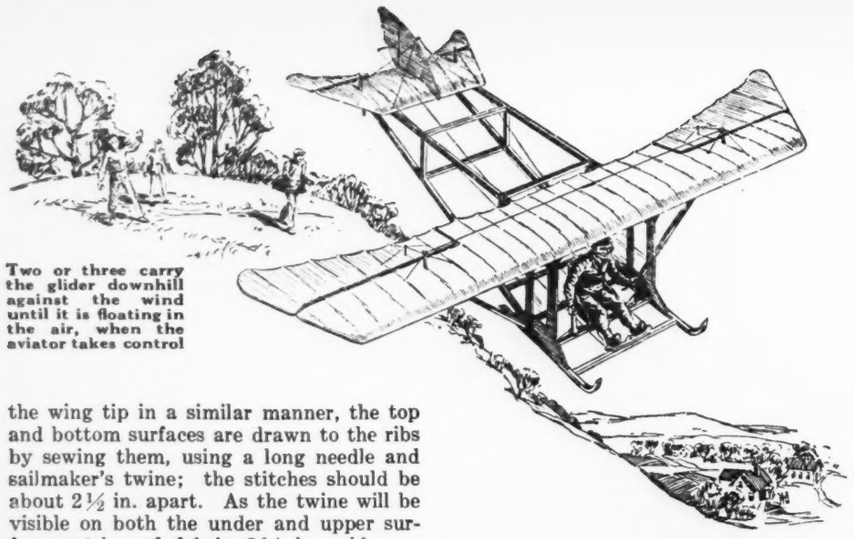
How the glider is assembled, the construction of wing ribs and side struts, and the aileron control system

Gluing the Fabric

The wings, rudders, and stabilizers may now be covered with a suitable fabric. For a glider a good quality of unbleached muslin will answer the purpose admirably. Spread the fabric across the top of the wing frame and apply a quantity of glue along the leading edge. Then fasten one corner of the cloth with several tacks and pull taut toward the wing tip, pressing the fabric on to the glue and tacking at intervals, being sure to keep the cloth tight.

The cloth is next brought tautly under the wing, pulled reasonably tight, and glued and tacked to the leading edge.

After the cloth has been secured around



Two or three carry the glider downhill against the wind until it is floating in the air, when the aviator takes control

the wing tip in a similar manner, the top and bottom surfaces are drawn to the ribs by sewing them, using a long needle and sailmaker's twine; the stitches should be about 2½ in. apart. As the twine will be visible on both the under and upper surfaces, strips of fabric 2½ in. wide are glued around the wing and on top of each rib to cover the sewing and strengthen the covering. A strip of fabric is also glued along the leading edge and wing tip, covering the lap of the cloth. The stabilizers and rudders are covered similarly.

The fabric is given at least four coats of airplane "dope," which shrinks the cloth, renders it airtight, and permits it to be spar varnished. The varnish further protects the fabric from the weather and adds materially to the glider's appearance.

It will be found that after the supporting surfaces are covered and the fabric has shrunk, the wire along the trailing edges will assume the scalloped effect illustrated in the several views.

Attaching the Struts and Skids

The vertical side struts are made by forming a laminated square with three boards all around, as shown in Fig. 6. The top and bottom of the square overhang the vertical sides so that they may be shaped to fit the wing and to carry the skids (Fig. 2). The struts are streamlined as shown in Fig. 6, after which they are spar varnished and secured to the specially heavy ribs.

The skids may now be attached, as well as the cross member that supports the operator's seat and the control levers, as shown in Fig. 3.

The diagonal struts are streamlined, secured with metal brackets, and further strengthened with wire braces; the vertical struts are likewise braced from their bottoms to the wing.

The 1-in. square booms or longerons that support the tail unit are attached to the vertical struts by means of metal tunnels, as shown in Fig. 5, fastened with staggered ¼-in. bolts.

The method of jointing and retaining the vertical and cross members to the fore and aft longerons is illustrated in Fig. 13. The upright and cross pieces are connected to the longerons with wooden dowels. The joint is then clamped rigidly between two sheet-metal fittings, Figs. 14 and 15, as shown in perspective in Fig. 13. The straps on these fittings are pinched together and form the leads for four of the five diagonal wire braces. The fifth brace fastens through the central hole in the smaller fitting, a recess being drilled in the angle of the wooden joint immediately behind the hole.

The horizontal stabilizer and elevators are secured to the upper longeron by metal clips which pass around the longerons and are bolted to the stabilizer cross beams.

The vertical stabilizer and rudder are secured to the center rib of the horizontal stabilizer by small angle brackets on each side and further supported by guy wires as shown in Figs. 1 and 2.

The vertical rudder control cables lead away to the longerons, where they pass through small pulleys and terminate at the pivoted rudder control bar as shown in Figs. 1 and 2.

The horizontal rudder control cables are led along the longerons, passing through pulley guides, and are made fast to the control lever shown in Fig. 3.

Fig. 7 clearly explains the aileron control.

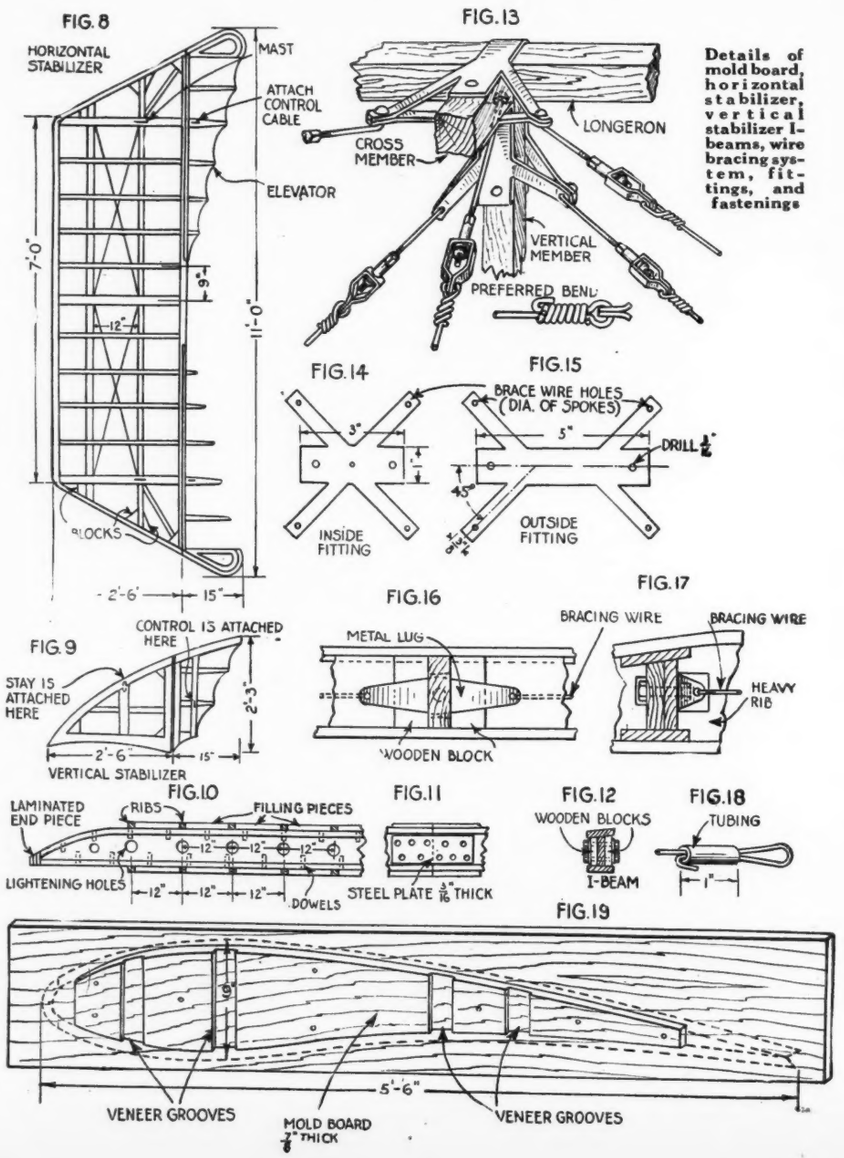
All control cables are of multi-strand steel cable ¼ in. in diameter and provided with turnbuckles for the purpose of adjustment. All guides should be well greased.

Testing for Balance and Alinement

To obtain the best possible results so far as the gliding angle and stability in flight are concerned, see that the parts are well balanced throughout and that everything is true and properly alined.

The last fine adjustments to get the center of gravity as nearly as possible in the same vertical line as the center of lift may be made by shifting the seat backward and forward a trifle. The amount will depend upon just how the plane has been constructed and how heavy the aviator is. Experiments can be made prior to the trial flights by resting the landing skids across a low triangular wooden support so that when the tail is raised to its proper relation with the wings, the whole plane will be free to tilt back and forth.

The seat is provided with a substantial



leather strap and buckle, and no glides should be undertaken without the aviator's being strapped in.

Be sure to use only sound, straight-grained spruce for the frame, and spare no pains to reduce the weight of every part and fitting to the lowest point.

To fly the glider, a suitable hillside must be chosen on a day when a medium breeze is advancing up the slope, so that the machine may be launched downhill into the wind.

Initial flights should be made from a point near the bottom of the slope. Never allow your machine to turn with the wind until you are an expert in handling it; put the nose down and make a landing in preference to flying with the wind.

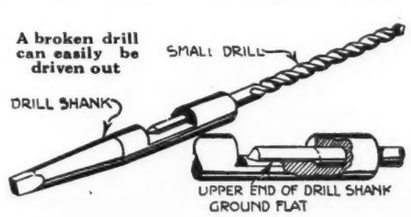
It is necessary to have at least three assistants to launch the machine. One of them takes hold of the diagonal struts on either side of the seat, into which you have strapped yourself securely. Wait until an extra heavy gust of wind comes along, then direct your assistants to advance downhill into the wind carrying the buoyant machine. As soon as you feel that the machine is thoroughly equal to supporting your weight, motion to your assistants to let go and immediately prepare to guide the machine by manipulating the various controls.

As your first glides will be short because of your low starting altitude, it is well to take the opportunity to experiment in the art of landing. Never attempt to land on your skid points, but come down more toward the heels of the skids. As soon as you feel the skids touch the ground, a slight deflection of the horizontal rudders will land you flat.

[It is most important that the curves of the wing rib section conform as closely as possible to Mr. Beach's design. For the benefit of those who wish to make the glider, the Home Workshop Service Department will furnish a full size paper pattern of the wing rib, as well as two sheets of blueprints, each about 14 by 18 in., for fifty cents. These blueprints contain substantially the same details as are reproduced on the preceding pages, but their large size makes them more suitable for a mechanic's use and the toughness of the paper will better withstand the wear and tear of shop handling.—THE EDITOR.]

Shank for Small Drills

THIS shank or collet for small drills has proved very satisfactory, particularly for sizes from 1/16 to ¼ in. From ¼ in. up, taper shanks can be purchased, but the ordinary chuck usually available for the smaller drills is not held in very high esteem by the practical shop man.



This taper shank can be sized to suit the usual straight shank drill and the end of each drill flattened off on one side to take the flat that is milled in the shank.

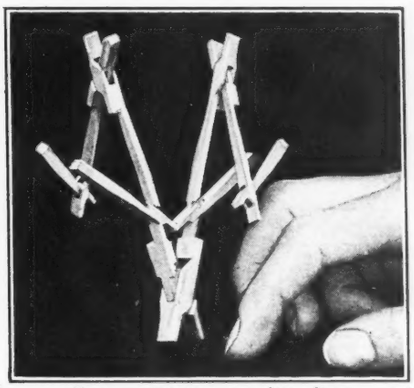
It will be noted that there is a gap between the end of the drill and the end of the milled slot in the shank. This is for the purpose of driving out the drill when it has to be replaced.—W. BURR BENNETT.

Bench Talks

Ingenuity Is Mainspring of the Home Workshop

By Arthur Wakeling

IN my desk I have a small bit of knife-work that recently came to me through the mails from a Nebraskan woodworker. The piece of wood is smaller than a fountain-pen, yet it is a perfect replica of a pair of pliers, and each handle contains three smaller pliers, making seven altogether. They all have the regulation pliers' joints

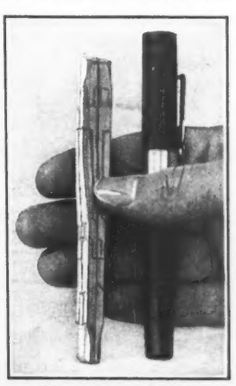


Seven miniature wooden pliers

and work freely and easily. Nevertheless, they are cut from a single piece of straight-grained pine. It is clear enough that the man who made this little model could, if he so desired, construct a carved period phonograph case with a penknife.

There was a time that might be called the "jack-knife period" in the history of the home workshop. Whittling was a favorite pastime. Any one who had whittled a chain from a stick of wood naturally would not feel backward in tackling the problems in construction and repair that come up around the house or farm. And there are still experts with the penknife. Several of my friends, one of them a lieutenant in the army, can do incredible things with a pocket knife, and they are all most ingenious in attacking every variety of mechanical problem.

I am not arguing that skill at whittling and ingenuity go hand in hand, but I do think that the splendid tools and equipment of the modern home workshop should be supplemented as much as possible by the inventiveness and resourcefulness that were such conspicuous characteristics of the home workshop half a century ago. The intense specialization of modern production and the substitution of machine for hand work tend continually to blind mechanics, whether in the shop or the home, to the fact that there are usually many ways to do a given job.

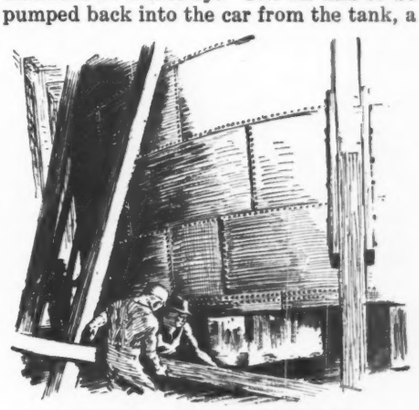


The pliers closed

Real resourcefulness is always interesting. I have in mind two recent examples. The first, described by Mr. G. W. Berg, of Arcadia, Fla., involved the problem of lowering a freezing-tank, about 24 by 30 ft., which had been built about 3 ft. above the floor so that the riveters would have plenty of room to work. After the riveting was completed, the floor was covered with an insulation of cork and asphalt 4 in. thick. The question then arose as to how to let down the tank and get all the blocking out and, at the same time, fill the holes where the blocking had stood with insulation.

"We got eight 300-lb. cakes of ice," Mr. Berg wrote, "and cut them crosswise, distributing them evenly under the tank, edgewise. We let down the tank on them and removed the blocking, filled the holes with insulation, and let the tank come down as the ice melted. To keep the tank from going sidewise, uprights were set and braced all around. When a cake melted too slowly, a fire was built over it, and it soon caught up with the rest."

The other instance occurred after 5000 gals. of the wrong grade of fuel oil had been unloaded at a factory. The oil had to be pumped back into the car from the tank, a



Lowering a tank on cakes of ice

lift of from 22 to 25 ft. The only available pump was of such limited capacity that it would have taken two men a long time to do the work. The master mechanic quickly devised the scheme of connecting a pneumatic drill with the pump spindle by means of a setscrew chuck so that the pump would run unattended. It pumped the oil back in eight hours at a saving of labor estimated at $15.

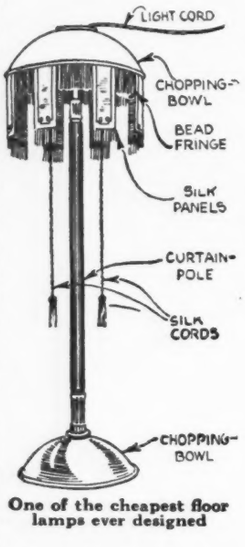
Ingenuity of this sort, more than any other single item, is what will make the home workshop successful.

Making a Coilspring

TO make a coilspring quickly and easily, place a breast-drill in a vise and into the chuck put a rod of the proper size for forming the spring. Grip one end of the spring wire in the chuck at the same time. Then, guiding the wire with one hand, turn the drill with the other.

Wooden Bowls and Curtain-Pole Make Attractive Floor Lamp

MAKING a floor lamp with chopping-bowls and curtain-poles has proved a good manual training project in our school. The materials cost little, the finished lamp is attractive, and no difficult construction is involved. Even the electric fixtures are of the simplest and most inexpensive kind. The wires do not run up through the shaft, but enter through the top of the shade—a neat and convenient method when the connection has to be made to a regular light fixture and there are no special floor outlets.



One of the cheapest floor lamps ever designed

The base is formed of a chopping-bowl about 14 in. in diameter and the shade is about 17 in. in diameter. The ordinary chopping-bowls are usually of maple, very smoothly turned, and they therefore take a very fine finish. A 6-ft. curtain-pole forms the shaft, and a wooden curtain-ring breaks the abrupt transition from the base to the vertical members. The pole can be decorated by simple flutings cut with a gouge, as shown. A heavy block of wood or some lead inside the base will provide sufficient stability.

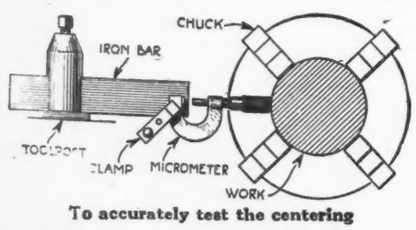
The shade, which can be finished in various ways, looks well with a fringe of colored beads and panels of silk with beaded edges. Silk cords and tassels add a further touch of grace to the lamp.

The inside of the upper bowl should be enameled white so as to reflect downward as much light as possible. The outside may be enameled green, if desired, in which case the beads and silk panels should be green or blue, or green and blue should predominate.—GLADSTONE CALIFF.

Micrometer as an Indicator for Lathe Work

IF a test indicator is not at hand to locate work so that it will revolve perfectly true in a lathe, the following method will give equal satisfaction.

Place an iron bar in the toolpost and clamp a micrometer caliper to it so that the back end of the barrel will be at the height



To accurately test the centering

of the lathe centers. Open the micrometer until the end of the barrel touches the work and take a reading. Then revolve the work and repeat the process at different points. When the reading is the same at all points, the work is centered.—R. H. KASPER.

Why Not Build Baby's Bassinet Yourself?

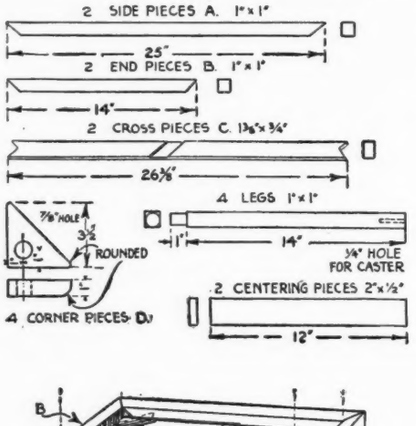
By Raymond W. Schuck

A BASSINET for baby that can be made as beautiful in appearance and as comfortable as some of the more expensive ones sold in stores will not cost more than $10, if constructed at home.

First obtain a large splint washbasket, preferably one 12 in. deep, 22 in. wide, and 34 in. long. This size basket will serve a baby comfortably until he is 8 months old.

A stand should be made from any straight-grained wood, as shown in the accompanying details. Nail the parts securely together, setting the nails slightly below the surface. Sandpaper the stand, fill all joints with putty or a filler, and give it one or two coats of flat white, followed by two coats of white enamel.

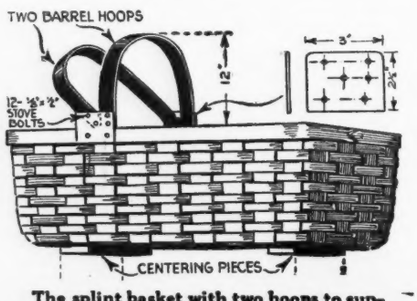
On the under side of the basket on each end are fastened pieces of wood that center the basket on the stand and prevent it from sliding off. The ribs for the hood are two



Details of the frame and how it is put together

barrel hoops, cut off and drilled to suit the holes in the metal brackets.

When the basket and stand have been completed, the bassinet is trimmed with blue or pink material. The ribs are wrapped so that the wood is entirely covered, and a piece of the stuff sufficiently large to go over the entire hood is secured in place. The outside covering is of dotted swiss, cut large enough to cover the hood. The end that is fastened to the front rib is folded back 5 in. and hemmed to provide for a drawstring for gathering it at the



The splint basket with two hoops to support the hood and two centering pieces fastened to the bottom

The appearance of the bassinet when completed

front rib. This edge is finished off with lace.

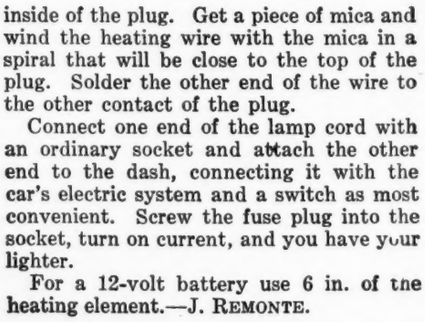
Another piece of the colored goods is carried completely around the basket and should be wide enough to extend down the inside to the bottom, as well as over the outside to 19 in. below the top of the basket. Cut the swiss for the outside of the basket large enough to cover the colored lining and fasten a ruffling around the top edge.

Finally blue or pink satin bows are attached to both sides of the basket where the front rib is fastened.

Make an Electric Cigar-Lighter for Your Automobile

A CIGAR-LIGHTER for your auto can be made by using a few odds and ends such as a blown-out plug fuse, a burned-out electric-iron heating element, an ordinary lamp socket, and a few feet of lamp cord.

Remove the cover from the plug and clean out the burned-fuse wire. Take 4 in. of resistance wire from the old heating element and fasten one end of it to the



The wind can't put this light out

inside of the plug. Get a piece of mica and wind the heating wire with the mica in a spiral that will be close to the top of the plug. Solder the other end of the wire to the other contact of the plug.

Connect one end of the lamp cord with an ordinary socket and attach the other end to the dash, connecting it with the car's electric system and a switch as most convenient. Screw the fuse plug into the socket, turn on current, and you have your lighter.

For a 12-volt battery use 6 in. of the heating element.—J. REMONTE.

Finding Minute Flaws in Metal

MINUTE cracks in hardened pieces are easily located if the work is oiled, wiped off, and then chalked. The oil remaining in the cracks quickly soaks through the chalk and becomes visible.

How to Make Small Castings in the Home Workshop

By Matthew W. Potts

HOME mechanics often find it impossible to carry out certain projects, owing to the impossibility of obtaining small castings. Foundrymen do not like to bother with small work even when good patterns are furnished. The workman must either make substitutes, which are generally unsatisfactory, or else abandon his plans.

With the simple outfit described in this article, the home worker may declare himself independent of the foundry and produce his own little castings as he needs them. The outfit is simple in construction, rugged, and easy to operate. It is also inexpensive both to construct and to operate. With it small bronze castings can be made up to 1½ lbs. in weight as well as castings of zinc, lead, and other metals.

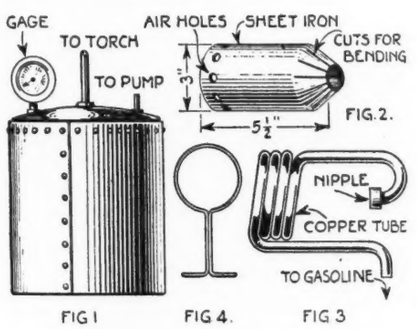
Old Kitchen Boiler Used for Tank

Let us start construction with the air and gasoline tank, Fig. 1. In the writer's case this was made by cutting up an old hot-water boiler. A 2-ft. length will do, fitted with a bottom. A metal disk the proper diameter can be welded in place at a welding-shop. An absolutely airtight joint must be produced. If the bottom cannot be welded, a good job of brazing may do the trick, or, as a last resort, use solder with a fairly high melting-point.

A small pressure-gage capable of registering about 50 lbs. should be obtained and screwed into place at the top of the tank. A connection for a small-bore pipe is also made in the center of the tank and another connection to accommodate a rubber hose at one side. This may be soldered or brazed in. After this is done, the central connection leading to the torch is temporarily corked up and the tank placed under water. An ordinary bicycle pump is then connected with the remaining inlet and air is pumped into the tank. If there are any leaks, bubbles will instantly rise to the surface of the water.

If the tank is absolutely airtight, work may be started on the rest of the apparatus.

The burner is of the ordinary gasoline type provided with preheating coils. The burner casing, Fig. 2, can be rolled into

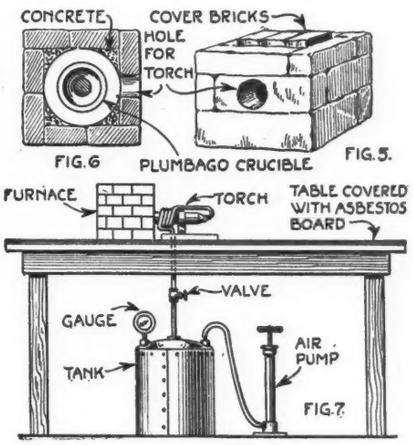


Tank, burner and preheating coil

shape from a piece of sheet iron, the air holes drilled, and the cylinder riveted. Make a few cuts at the mouth with a pair of snips and bend the sheet iron in toward the center.

The preheating coil, Fig. 3, is made from small copper tubing with a ⅛-in. bore, such as is used for auto lubricating systems. Almost any garage will be able to furnish a small amount of this; 3 ft. will be sufficient. Straighten out the tubing and pour melted resin or paraffin into the tube to prevent it from flattening when it is bent around a wooden mandrel, slightly larger in diameter than the sheet-iron casing. A mandrel about 3½ in. in diameter will do nicely. The turning can be done in a lathe or the mandrel may simply be mounted in a vise and four turns of the tube made around it.

About 8 in. of tube are left at each end of the coil. One end is then bent as shown so that it will come directly in the center of the casing when it is slid in the coil. A



The complete outfit and details of the furnace

nipple with a .020-in. orifice is brazed to this end of the tube. These nipples, which may be purchased at any hardware store, are made especially for blowtorches. Solder should not be used.

The preheating coil is mounted over the casing and the little clamp shown in Fig. 4 is made from sheet iron. This is bent into shape from a single strip, riveted tightly about the torch casing and screwed to the asbestos-covered stand.

A little masonry work will now have to be done, but this is not as difficult as perhaps it seems. It is, of course, necessary to obtain firebricks for this purpose. The writer used a brand of very soft brick similar to soapstone that may be cut with an ordinary saw. It has splendid heat-insulating qualities and even when the furnace is at its full heat, the hand may safely be placed on the outside. These bricks come in rather large sizes, so it is necessary to cut each one into two or three pieces.

Figs. 5 and 6 show how the furnace is built up. A 2-in. hole is left in one side for the torch. This does not have to be a perfect circle, but the torch should fit in it as nicely as possible. The furnace walls are of single thickness. When they are made, a circular piece of sheet metal is placed inside, leaving a space in each corner. The corners should be filled in with a paste of asbestos and waterglass tamped lightly into place. When it has become fairly dry, the circular piece of sheet metal is removed. This will make the inside wall of the furnace circular in shape so that when the flame enters, it will tend to envelop the entire crucible. Two other bricks are used to cover the top of the furnace. They should fit snugly so that no large cracks will permit heat to escape.

An old table covered with asbestos board, or sheet metal may be used as a stand. The torch is mounted, Fig. 7, so that its nose will enter the hole in the side of the furnace. The tank is placed under the table and a connection is made between it and the free end of the preheating coil. A small valve is interposed on this line so that the gasoline and pressure may be cut off whenever necessary.

To start the outfit, the preheating coils on the blowtorch must be brought to a rather high temperature with an ordinary blowtorch. While the preheating coils are being heated, pressure should be produced in the tank with the bicycle pump after about a gallon of gasoline is placed in the tank. The gasoline may be put in the opening through which the air passes or a separate little filling plug can be provided.

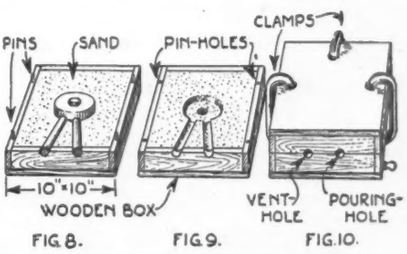
When the pressure has been raised to 10 or 15 lbs., and the preheating coils have been heated to the proper temperature, the valve on the feed line is opened. The torch should immediately start with a roar, shooting a hot flame into the furnace. As the gasoline supply must pass through the preheating coils on its way to the nipple, it will become highly vaporized. After the torch is started, the preheating coils will be heated automatically.

The scrap metal to be melted for castings is placed in a small plumbago crucible. One hour to 1½ hours will be necessary to bring the metal to the proper temperature for pouring. In extreme cases it may be necessary to operate the outfit for a longer period.

Before making a casting, a pattern must be provided and a casting-box made. Details of this box are shown in Figs. 8, 9, and 10. It is 10 in. square, made in two halves. Brass screws are used throughout. Four pins are placed in one half of the box and corresponding holes are made in the other half.

Preparing the Molds for Casting

Twenty-five or 30 lbs. of fine molding-sand should be obtained at a local foundry. This is sifted through a flour-sifter. Enough sand to fill both halves of the box is dampened with water and each half is filled and levelled off with a straightedge. The pattern is pressed into the sand in one half of the box, not quite halfway down. Then the other half of the box is put on and the halves are pressed together. Before this is done, two skewers are put in place as shown. When the box is taken apart, an impression will be left as in Fig. 9. Both the skewers and the pattern are removed. The skewers leave two passages from the outside of the box to the impression in the sand. One of these is for the

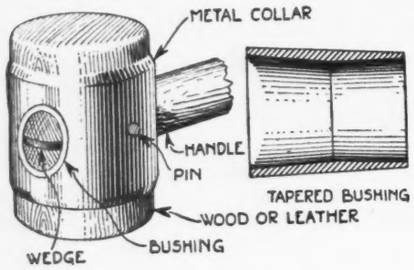


Preparing the mold for pouring

escape of air while the molten metal rushes in and the other is for the passage of the metal. During the actual pouring, the two halves of the box are held together with wooden clamps as illustrated in Fig. 10.

Fastening a Soft-Faced Hammer to Its Handle

RAWHIDE or wooden mallet-heads may be securely fastened to their handles in the manner shown in the illustration. Between the head and the handle a bushing is placed, tapered on the outside to prevent the head from slipping off. The



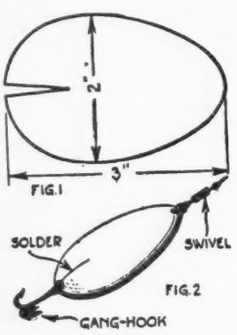
This mallet head has little chance of loosening

side of the bushing that is in contact with the handle has a double taper, as shown in the picture.

After the head is driven on and secured by a pin driven through the head, bushing, and handle, it will be held immovably. The wedge driven into the top of the handle prevents the head from becoming loose if the wood of the handle should shrink.—C.H.

Try This Wobbling-Spoon

WITH a wobbling-spoon made from the rim of an old alarm-clock many a big fish may be lured to destruction. This type of spoon hook is radically different from the regulation trolling-spoon, the object being to imitate the erratic motions of a disabled fish in the water and therefore the more certainly to attract the larger preying fishes.



A novel fish lure

The spoon was cut pear shaped (Fig. 1), slotted in one end, drawn together, and soldered on the inside so that it was cup-shaped on the inside. The edges were slightly crimped in all around and the inside painted red. A swivel was wired to a hole in one end and in the other a gang-hook was fastened (Fig 2.).—R. P. L.

Electric Switch Protector

ELECTRICIANS occasionally receive severe burns when they open the field switch of a motor. The heavy current passing through the switch causes a momentary arc and generates intense heat. The asbestos protector illustrated will shield the hands from this excessive heat.

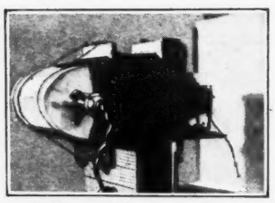
The flap forms a shield

Two pieces of heavy sheet asbestos are used. They are flexibly connected by two metal rings.—W. C. ROYER.

How to Make an Electric Enlarging Machine

By Lloyd Ringer

MAKE a box of ⅜-in. stock—pieces of a soapbox will do—as long as twice the thickness of your camera, as high as the film used is long, and as wide as the film. A 3¼ by 5½ in. film will require a box about 4 in. long, 5½ in. high, and 3¼ in. wide. Both ends of the box are left open.



The machine complete

On one end make a slide frame by gluing on strips, or cut a frame out of cigar-box wood, the inside being about ⅛ in. smaller than the box. A glass slide is next made by cutting two pieces of ordinary window-glass the proper width to fit in the frame, fastening them together at the bottom with adhesive tape. The glass should be long enough to extend 1 in. above the top of the box to allow it to be handled easily.

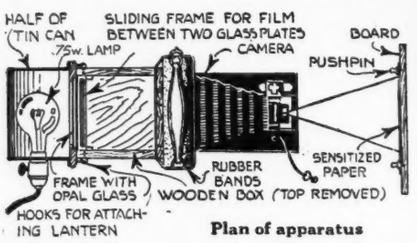
On top of the box at the other end fasten across the box a 2-in. strip of wood on edge. On the bottom is fastened a support or little shelf extending just low enough to allow the inside edge of the camera to meet the inside edge of the box when the camera, which is of the folding type, is fastened to the piece on top of the box and the support on the bottom with large rubber bands. The box itself should be mounted on a stand, which may be designed to suit the taste of the maker.

The electric lantern can be made from an old varnish can. Cut out two squares as long as the negative and cut off two corners of each, making two semicircles. Then cut a strip as wide as the film and long enough to go around the round part of the tin semicircle. Bend up the edges of the semicircles so that the long strip can be fitted into them and soldered. The opening in front should then be very nearly the size of the film. A hole is cut in the center of one semicircle the size of an electric socket, care being taken to make it small enough so that the socket will fit tightly. A 75-watt nitrogen lamp should be used.

A frame is made with inside dimensions the same as the film, and a piece of opal glass is fitted into it. This is fastened between the lantern and the box by wiring it to the lantern with picture wire. Four hooks are screwed into the frame to engage four screw-eyes on the sides of the box. Felt between the joints will stop all light.

An easel is easily made by fastening two shelf brackets to a board 18 in. square.

The enlarging camera must be operated in a darkroom. Place a negative in the glass slide, preferably upside down for focusing purposes. Then put the slide in box with the face of the negative toward the easel. Turn on the light and open the shutter in camera. The image will appear



Plan of apparatus

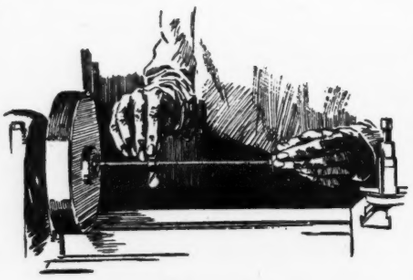
on the easel more or less blurred, but by moving the latter backward and forward and adjusting the camera bellows, the proper focus may be obtained. After the image is focused, put a piece of blank paper on the easel to meet the picture. Then turn off the light and put a piece of bromide paper over the blank paper; stop down the camera to about f16, turn on the light and make the exposure. Ordinarily about 25 seconds with an average negative will be sufficient. Develop in usual manner.

Count the Revolutions of Your Machinery

By Lowell R. Butcher

ANY one owning or operating machinery likes to be sure that he is operating his engine at the speed recommended by the manufacturer. Engines are most efficient at their rated speed, consequently it behooves the owner to obtain the right setting for his governor.

A revolution counter that is easily made is shown in the illustration. It will register with an accuracy that is correct within a few revolutions a minute. A piece of ¼-in. to ⅜-in. rod will do for the stem. The ¼-in. is probably the better, as a standard thread of that size has more threads to the inch. The piece used should be from 10 to 12 in. long and threaded, except for about ½ in. at one end. This end is fitted with a cap that turns smoothly on the rod and is large enough to afford a convenient handle for the instrument. The threaded end is pointed and knurled or roughed, so that it may be pressed against the center of the shaft and rotate with it. A suitably shaped handle, tapped to suit the size of the rod, is fitted to it.



Though extremely simple of construction, this homemade tachometer gives accurate results

To count the number of revolutions in a given length of time, screw the tapped handle to one end of the stem (depending upon the direction of rotation of the shaft), press the knurled end firmly against the rotating shaft, and hold the tapped handle to prevent it from turning. By observing how many turns this handle advances in a given length of time, it is easy to compute the revolutions a minute. Supposing you are using a ¼-in. rod for the stem, having 20 threads to the inch and that the handle advances 6½ in. in twenty seconds. It is easy to figure that 130 revolutions will be made in ten seconds and that 780 would be made in one minute, providing the same speed is maintained.

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To get good results with a wireless telephone you must have a reliable battery. The Willard All-Rubber Battery has back of it the same long battery experience, and is built to the same standards as the Willard Threaded Rubber Automobile Battery, which is now standard equipment on 191 makes of cars and trucks.

Every day there are radio concerts. Dance music and vocal selections, classical music and the latest popular "hits" are being sent out regularly by radio-telephone. Some of it is probably passing unheard through your own home.

All that's needed to make this music heard—and as near to you as your own phonograph—is a simple radio-receiving set.

There are dozens of these sets all made up and ready to use. There are scores of plans available for those who prefer to make up their own sets.

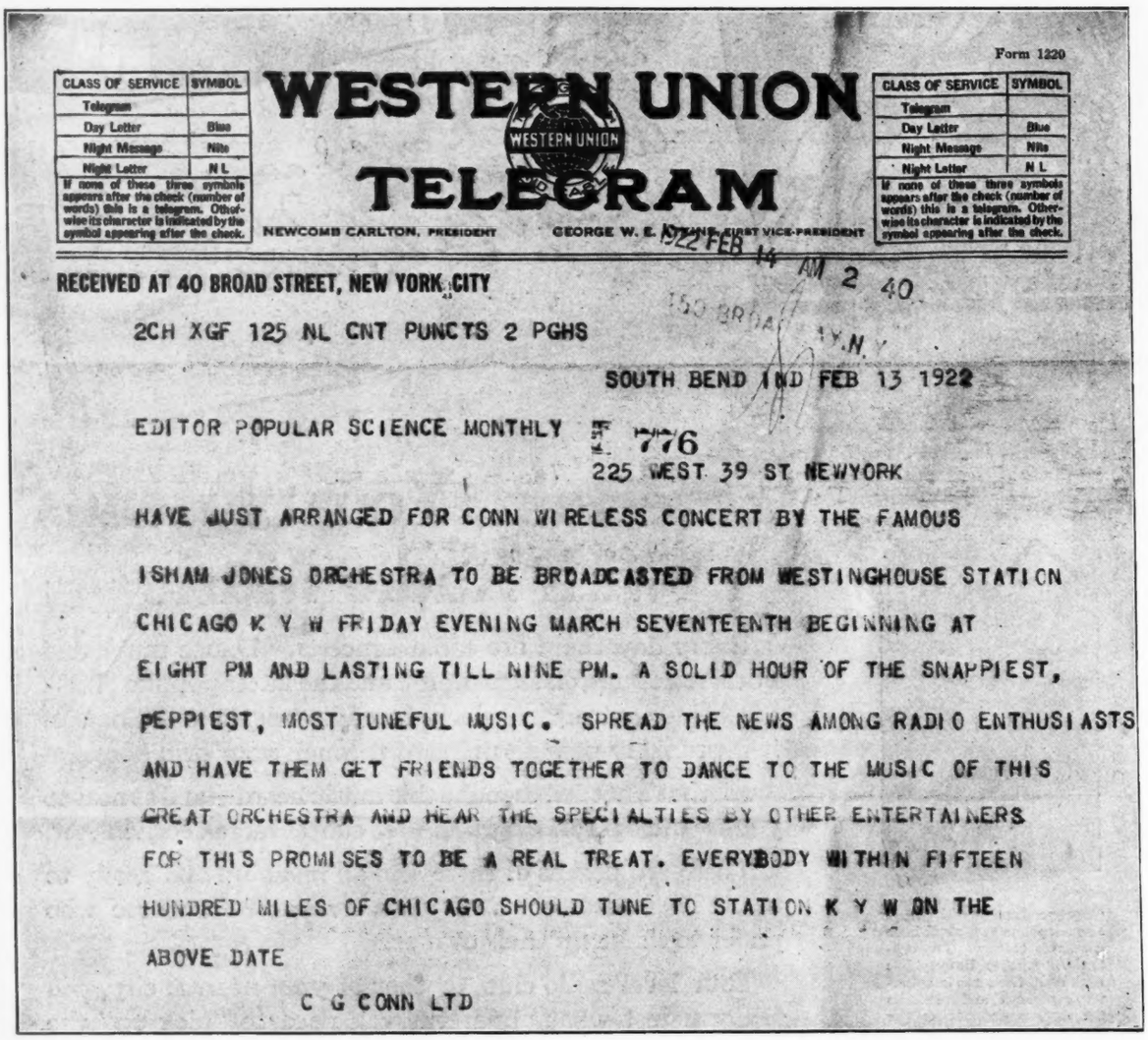
Your local radio club, or that of your nearest city, will tell you just what apparatus you need to "pick up" the concerts, and the news, weather and market reports that are in the air.

WILLARD STORAGE BATTERY COMPANY
Cleveland, Ohio

Willard Storage Battery Company of Canada, Limited, Toronto, Ontario, Canada

Willard THREADED RUBBER BATTERY

A Message From Conn To All Radio Enthusiasts!



Form 1220

CLASS OF SERVICE	SYMBOL
Telegram	
Day Letter	Blue
Night Message	Nite
Night Letter	N L

If none of these three symbols appears after the check (number of words) this is a telegram. Otherwise its character is indicated by the symbol appearing after the check.

WESTERN UNION

TELEGRAM

NEWCOMB CARLTON, PRESIDENT — GEORGE W. E. ATKINS, FIRST VICE-PRESIDENT

RECEIVED AT 40 BROAD STREET, NEW YORK CITY

1922 FEB 14 AM 2 40

2CH XGF 125 NL CNT PUNCTS 2 PGHS

SOUTH BEND IND FEB 13 1922

EDITOR POPULAR SCIENCE MONTHLY F 776
225 WEST 39 ST NEWYORK

HAVE JUST ARRANGED FOR CONN WIRELESS CONCERT BY THE FAMOUS ISHAM JONES ORCHESTRA TO BE BROADCASTED FROM WESTINGHOUSE STATION CHICAGO K Y W FRIDAY EVENING MARCH SEVENTEENTH BEGINNING AT EIGHT PM AND LASTING TILL NINE PM. A SOLID HOUR OF THE SNAPPIEST, PEPPIEST, MOST TUNEFUL MUSIC. SPREAD THE NEWS AMONG RADIO ENTHUSIASTS AND HAVE THEM GET FRIENDS TOGETHER TO DANCE TO THE MUSIC OF THIS GREAT ORCHESTRA AND HEAR THE SPECIALTIES BY OTHER ENTERTAINERS FOR THIS PROMISES TO BE A REAL TREAT. EVERYBODY WITHIN FIFTEEN HUNDRED MILES OF CHICAGO SHOULD TUNE TO STATION K Y W ON THE ABOVE DATE

C G CONN LTD

Hear This First Conn Concert

The telegram tells the story. Be sure to take advantage of this opportunity to hear one of the world's greatest dance orchestras, playing Conn instruments exclusively, in this first of a series of concerts to be announced from various stations. Concert arranged by courtesy of Westinghouse Company, through Morgan L. Eastman, musical director. Remember the date

FRIDAY EVENING, MARCH 17

Chicago Westinghouse Station KYW

(Wave Length 360 Meters)

An Hour's Concert 8 P. M. to 9 P. M.

C. G. CONN, Ltd. **432 Conn Bldg.** **Elkhart, Indiana**

Why Isham Jones, Ted Lewis, Paul Biese, Joseph Smith and Other Popular Stars Choose Conn Instruments

Because exclusive features and superiorities in manufacturing methods make these instruments not only the most beautiful in tone, most perfect in tune and mechanism, but *easiest of all to play*, as well.

The members of Isham Jones orchestra, which will give the first Conn Wireless Concert announced on the opposite page, all play Conn instruments and declare them beyond doubt the finest ever made. Note what the other leaders pictured on this page say, and then remember these are but a few of the top notchers who use and endorse these world-famous instruments!

Isham Jones Orchestra: "Conn instruments certainly give us highly satisfactory results."

Ted Lewis and his Jazz Band: "Conns possess the tone and intonation and *play so easily.* In a word, they satisfy."

Paul Biese, famous Saxophone soloist: "You are making a marvelous instrument, without doubt the best I have ever played."

Joseph Smith, director Smith's Orchestra: "Your reputation as the best builders of band instruments has been justly earned."

Benson's Orchestra: "All members of the Benson orchestras are enthusiastic about your instruments."

Here Are Some Features of the Conn Saxophone, *the World's Finest*

Tapering tube expanded to perfect proportions by hydraulic pressure which gives a smooth-as-glass interior, making the Conn *easier to play*, yielding finer tone.

Tone-hole sockets drawn from tubing, not soldered, preventing leaks.

Rolled edges on sockets preserve life of pads.

Pads made over metal rings, preventing warping and sustaining shape.

Patented device enables tuning to finest degree, can be operated while playing.

Such improvements have made Conn, the first American maker, now the largest producer of Saxophones in the world.

You Can Learn the Saxophone Play a Tune in One Hour!

Many without previous musical experience have done it; *you* can do it. There's extra profit and pleasure, playing part time, or whole time, in band or orchestra. Engagements open nightly.

Send for New Saxophone Book FREE and details of FREE TRIAL; EASY PAYMENT plan on any Conn instrument. Book tells how to use saxophone singly and in combinations, illustrates and describes exclusive features and complete Conn line. Get your copy now. There's no obligation. Merely send the coupon.

C. G. CONN, Ltd.,
432 Conn Bldg., Elkhart, Indiana
World's Largest Manufacturers of High Grade Band and Orchestra Instruments

New York Conn Co., 233-5-7 W. 47th St.
Detroit Conn Co., 59 Grand River Ave.
Northwest Conn Co., 798 3rd Ave., Seattle, Wash.
McDougal Conn Co., 129 10th St., Portland, Ore.
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Gentlemen: Please send me your new Saxophone Book and details of free trial easy payment plan.

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Street or Rural Route.....

City..... State.....

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Instrument.....

500 out of 500

The remarkable performance of T. K. Lee with a Stevens rifle

Using a Stevens rifle, in an N. R. A. individual championship match, Mr. Lee hung up the clean score of 500—or fifty perfect bull's-eyes.

But not content, he continued shooting for a record, and ran 48 additional bull's-eyes before dropping into a nine. This gave a record score of 98 straight, perfect bull's-eyes.

Every Stevens rifle or shotgun has this built-in accuracy that was behind the skill of Mr. Lee.

The secret is in the barrel

Stevens uses a special process, slow scraping system of reaming, the final boring cutting a depth of only $\frac{1}{1000}$ of an inch.

It's a slow method of rifling a barrel; it takes long, painstaking work. But when it's finished the barrel is accurate. No flaws, no protruding hard spots. Don't forget that.

After being bored and rifled, every Stevens barrel goes through an intricate polishing process. This gives a finish which repels pitting and leading, and retains permanently its original accuracy.

You economize three ways on a Stevens

Remember this: when you buy a Stevens, you get the last word in accuracy; you get a gun that will last a lifetime; and you get that gun at an exceptionally low price.

Stevens manufactures a complete line of small bore rifles and shotguns of every description.

Ask at your dealer's or write for the interesting catalog describing in detail our complete line. Address:

J. STEVENS ARMS COMPANY
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Owned and operated by the Savage Arms Corporation, Executive and Export Offices: 50 Church Street, New York

The famous Stevens Guarantee

Every firearm turned out by the Stevens Arms Company has attached a tag on which is printed the Stevens guarantee. This tag is your insurance for Stevens quality and workmanship. Read carefully this guarantee.

Stevens

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An interesting book written in non technical language for the man buying a small Radiophone Receiving Set to listen to Opera, News, Reports Lectures, Concerts, etc., by

Lee DeForest, Ph.D., D.Sc.

the world's foremost inventor and pioneer in the Radio field. Contains: Explanation of the Theory of Wireless, Its Value in the Home, Essentials of a Receiving Station, How to Erect an Antenna, Purposes and Uses of Equipment, The Amplifier. Illustrated with Photographs and sketches. Covers anything you will want to know about Wireless. Send 15c for it now.

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Are you fond of outdoor work? Would you like to become a Civil Engineer? Then take up Surveying. It not only pays big salaries itself, but it is the stepping stone to something even better. You can learn at home. Write for particulars.

INTERNATIONAL CORRESPONDENCE SCHOOLS, Box 7675-B Scranton, Penna.

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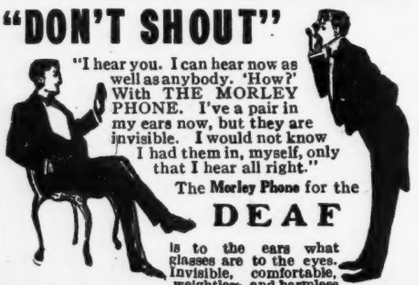

"I hear you. I can hear now as well as anybody. 'How?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

The **Morley Phone** for the

DEAF

is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless.

Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.

THE MORLEY CO., Dept. 797, 26 South 15th Street, Philadelphia

The "Best Idea" Prize Contest

SEND your "best ideas" to the Home Workshop department, for you may win one of the prizes awarded monthly as a bonus for especially good suggestions. A first prize of $15 and a second prize of $10 are given in addition to regular space rates for the "best ideas" published each month.

There is probably not a single reader of POPULAR SCIENCE MONTHLY who has not in his experience run across just the sort of idea that might win a prize. Keep your articles as short as possible and illustrate them with sketches or photographs or both.

The April prize winners are:

FIRST PRIZE, $15: **Joe V. Romig,** Allentown, Pa. (Page 95)

SECOND PRIZE, $10: **A. A. Millner,** Bogota, N. J. (Page 102)

The present "Best Idea" offer runs until June and will be followed by a similar contest.

Home Workshop Readers Write of New Blueprint Service

NOT only has the demand for Home Workshop blueprints exceeded the expectations of the editors, but the general interest shown in the new service by readers from all over the country has also been indicated by the many letters of approval which they have written. Extracts from a few of the letters follow:

RECEIVED your blueprint and must say it is one of the best ideas your magazine could have offered its readers. I am a steady reader of your magazine and will send for your next blueprints.
CHARLES W. HAHNEMANN, Newark, N. J.

I HAVE tried to make different pieces of small furniture, but have been handicapped by guesswork, and gave up in disgust. Now I feel satisfied I shall be able to do the job as it should be done with the help of the Home Workshop.
JAMES E. FORR, Altoona, Pa.

BEING a regular reader of your most interesting magazine, I take pleasure in saying that I think you have struck quite a novel idea in your new "Blueprint Service," and I am sure that it will be a great help to all who take an interest in it. For myself, I like making small pieces of furniture, but not having any drafting experience, do mostly all my work by guessing, and one cannot make an excellent job by that method.
J. E. CASPEL, Toronto, Ontario.

I AM very much enthused about the POPULAR SCIENCE new Blueprint Service to home workers, and I know that the Blueprint Service will make the POPULAR SCIENCE MONTHLY the best mechanical magazine published.
JAMES A. HUBER, Monrovia, Calif.

YOUR magazine is one of the best published, and I sure enjoy reading it. One can get so many different ideas for doing things.
W. N. RUDY, Covington, Ky.

I THINK it is the best idea yet, and I am sure there are lots of other fellows who will appreciate it as much as I do. Thanking you for the blueprint and wishing you all success with the new idea, I am,
EUGENE M. SMITH, Framingham, Mass.

THE design appears excellent to me, as indeed does the idea of this service to your readers. Not only the full details, but the complete list of materials required, will be invaluable in making for more perfect work and in the saving of time and material.
A. EVANS ELLING, Nutley, N. J.

MY hobby is woodworking at home in my spare time. Will appreciate your unusually low price of blueprints with all details included, and will be able to make my work more complete. Your magazine is invaluable, as the many hints on workshop problems are of great help both to the amateur and professional workers.
RICHARD HAZARD, Memphis, Tenn.

I NOTICED in the February issue of the POPULAR SCIENCE MONTHLY, that you have started a Blueprint Service. I am sure it will create even more interest in the Home Workshop department.
ROBERT C. WACHS, Cincinnati, Ohio.

THE HOME WORKSHOP

A "Hopping" Stick Will Give the Youngsters No End of Fun

By Roland B. Cutler

BOYS and girls will find great fun in this easily made "hopping" stick. It is something like a stilt and has footrests upon which one stands and jumps along like a frog. To make it you'll need only one piece of hardwood, ⅞ in. thick, 3½ in. wide, and 40 in. long. At the hardware store, get two 4-in. corner braces, two 9-in. doorsprings, and two pipe-straps, ½-in. gaspipe size.

Measure off 30 in. of your piece of wood and mark it so that you can cut out a 1½-in. center. This is to be the leg *D*, therefore saw carefully and cut out the semi-circular end with a keyhole saw. Measure 8 in. from the bottom of the foot piece and attach the corner braces with screws, one on each 1½-in. side as shown. You will stand on these, 8 in. above the ground, when stick is complete.

Cut off 2 in. of the forked end of the other part. From ⅞-in. stuff, cut the two bottom cleats, *C*, each 3½ in. long and 2 in. wide. Place the leg between the forks as shown, and nail on the cleats at the fork

How the stick is made and used

ends, below the braces. Attach the pipe-straps with screws, 11 in. from the end, as at *B*.

From ½-in. stock, cut the two cleats, *A*, each 3 in. long and 1 in. wide. Bore a hole in the center of each, and on each side attach one end of a spring with a screw. On each side of the spring ends drive small nails into the top of the leg to hold each cleat firm and square.

With a stout cord connect the other spring ends to the pipe-straps. You will have to experiment with the tension; the pull should be such that the springs will barely "give" at a little hop. Having adjusted this, stand on the foot braces and mark the handle end for cutting off at a point about 2 in. above your waist. Shape this end for a hand hold from 3 in. above the leg opening to the top.

Although you will touch only the high places, you can secure a better grip on the ground with a rubber tip, such as a crutch rubber, slipped on to the foot.

Removing Paint from the Hands

IT is not advisable to use turpentine or benzine in removing paint stains from the hands. By oiling them thoroughly, and then carefully washing with soap, the paint may be removed, provided it has not been allowed to dry too thoroughly on the hands.—K. W.

One of the 250,000 who provide Bell Service.

At Your Service

Imagine a bird's-eye view of the United States. Imagine it criss-crossed with telephone wires or underground cables connecting every city, town and hamlet. Imagine these wires reaching nearly 14,000,000 destinations—in city homes and offices and in 2,500,000 farmhouses.

Imagine all this and your vision is still short of the truth regarding the Bell System. A telephone at your elbow, a wire circuit to your farthest neighbor. Apparatus which embodies the latest developments of an army of trained scientists. The picture is still incomplete.

In every center of population is a telephone exchange and an organization of skilled workers to give life to the nation-wide facilities of communication. Every circuit must be tested; every inch of wire watched and kept in repair; every switchboard operated day and night.

But that is not all. There is the new construction to meet the increasing needs of the telephone-using public. Every day, from one end of the country to the other, thousands of crews of linemen and cablemen, and installers of every kind of telephone equipment, carry on this work with the continued growth of the nation.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service, and all directed toward Better Service

HOW TO CONDUCT A RADIO CLUB

E. E. Bucher

Covers parliamentary procedure, indoor and outdoor experiments, 5,000-mile receiving sets, vacuum tube amplifiers and detectors, and many other subjects.

148 pp. Fully illustrated. Price 75c

POPULAR SCIENCE MONTHLY

225 West 39th Street, New York City, N. Y.

PRACTICAL AMATEUR WIRELESS STATIONS

This book contains best suggestions of thirty-three experimenters on building, installing and operating experimental stations for radio communication.

Profusely illustrated. 136 pp. Price 75c

POPULAR SCIENCE MONTHLY

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NEW CORD TIRES Guaranteed 8000 Miles

Brand New—High Grade—Strictly Firsts

Here is your opportunity to buy **New High Grade Cord Tires** dirt cheap. Fresh stock—strictly firsts. Manufacturer's name and serial number. In original wrapper. The greatest tire sale this season. Values which cannot be duplicated anywhere offered at tremendous sacrifice.

Standard Make Tube Given With Each Cord and Fabric Tire

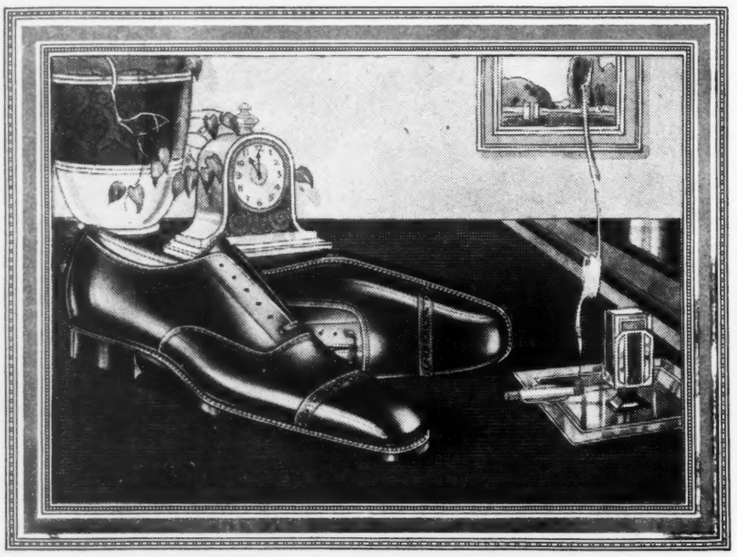
These big sturdy, substantial cords, are built of new strong, fresh material by a well known manufacturer, who guarantees every tire to be free from defects and workmanship. **Our slashed prices** are far lower than any other standard tire, yet we absolutely guarantee our cords to give full 8000 miles service.

Sizes	Cords	Fabrics	Size	Cords	Fabrics	Sizes	Cords	Fabrics
30x3	$ 9.95	$ 7.10	32x4	$17.50	$11.25	35x4½	$25.75	$15.30
30x3½	11.75	8.45	34x4	18.95	11.95	36x4½	26.15	17.70
32x3½	14.40	9.25	32x4½	23.50	13.90	33x5	26.75	19.00
31x4	15.65	10.50	33x4½	24.10	14.50	35x5	28.00	20.50
32x4	16.90	10.70	34x4½	25.00	14.95	37x5		21.50

Send No Money—All tires sent, no money, down for your examination. Pay only after convinced of the tremendous bargain value. State whether Cord or Fabric are wanted. We allow special 5 per cent discount if full cash is sent with order.

Webster Tire Corporation, 110 S. Dearborn St., Dept. 19, Chicago, Ill.

THE FLORSHEIM SHOE



WHEN you view your first pair of Florsheim Shoes — remember that their splendid appearance, you so greatly admire, is not merely a surface finish; but a "built-in" quality that will endure for months of constant hard wear.

Florsheim Low Shoes are Skeleton Lined and Non-slip — they fit the ankle and hug the heel.

The Florsheim Shoe, $10 — A few styles, $11 and $12
Booklet "*Styles of the Times*" on request

THE FLORSHEIM SHOE CO.
Manufacturers Chicago

Tire Agents Wanted
An auto owner in each locality to use and introduce Mellinger Extra-Ply and Cord Tires. Make big money part or full time. No capital or experience needed. Sample Sections Furnished. GUARANTEED **8,000 & 10,000 Miles** (No Seconds). Hand made. Finest materials. Shipped prepaid on approval.
FREE TIRES FOR YOUR CAR to one user in each locality. Be first to write quick for special Agents Offer and Low Wholesale Prices.
MELLINGER TIRE & RUBBER CO.
962 North Oak St. Kansas City, Mo.

Only $45.00 For This Job Complete

Save exorbitant freight rates and one-half original cost by buying Ford Speedster Bodies knocked down. Simple, complete instructions furnished, all parts cut to exact fit. Any one can assemble this job. Complete with hood, radiator shell, instrument board, upholstering, metal parts, wood parts, bolt screws, etc. Flat radiator shell furnished made up. Designed low with lack of wind resistance. Price set up $90, further particulars on request.

Not Paper Patterns
All Parts Complete

The Central Auto Supply Co. Eng. Dept. 122 Louisville, Ky.

Build an **Aladdin** Save $200 to $800

Aladdin success is chiefly due to the money saved for Aladdin Home owners.

You will save a substantial amount through eliminating dealers' profits, saving over 18% waste in lumber and lowering labor costs in building. Aladdin Homes are cut to fit, saving waste of lumber and hundreds of hours of carpenter labor. Over a hundred beautiful homes are pictured in the Aladdin catalog. Send stamps for this catalog No. 1707 at once.

Sold Direct—No In-Between Profits

The Aladdin Company is the greatest home-building institution in the world and it does not sell through dealers. It manufactures the lumber at the edge of the four greatest timber-producing states. It prepares the house complete, ready to be shipped direct to the home builder. You save the dealers' profits. Your carpenter nails the readi-cut lumber just like in any other first-class, permanent home. The catalog explains the details fully.

What You Get When You Buy an Aladdin

Aladdin Homes are designed to use standard lengths and sizes of lumber so that there is practically no sawing, measuring and fitting to be done by the carpenter on the job. You receive in one shipment all the timbered frame work, mill-work, the siding, outside finish, porch, shingles, windows, doors, interior woodwork, lath, glass, nails, hardware, lock sets, paints, stains and varnish. Send stamps today for catalog No. 1707

ALADDIN 1906 Sold By the GOLDEN RULE

The Aladdin Co., Bay City Michigan

Branches (Offices and Mills) Wilmington, N. C. Hattiesburg, Miss., Portland, Oregon

Canadian Offices and Mills; Toronto, Vancouver, Winnipeg, St. John

THE HOME WORKSHOP

Tools that Will Make Your Home Complete

A MAN never wakes up to the sheer delight of making things for the house until he can boast of a home workshop completely equipped with up-to-the-minute tools for every need.

But when he has his ideal tool outfit, he finds himself itching to make use of it constantly. The result is a better furnished, handsomer, more comfortable, and more convenient home. For the tool-owner is forever at work around the house, and his tools become the chief foe of depreciation.

When it comes to buying tools, a man who has not done much work with hammer and saw and remembers perhaps only faintly the more or less abbreviated outfit he used when doing manual training at school, often finds it difficult to decide just what will best suit his purposes.

For doing repair jobs around the house and garden and for simple woodworking, the following tools will be found adequate and satisfactory—a typical "handy man's" set that no household should be without:

1 Handsaw, 22 in.
1 Adze-eye nail hammer, 1 lb.
1 Screwdriver, 6 in.
1 Brace, 8 in. sweep
4 Auger bits, ¼, ⅜, ½, and 1 in.
2 Gimlet bits, 1/16 and ⅛ in.
1 Screwdriver bit, ⅜ in.
1 Jack plane, iron or wood bottom, or 1 smooth plane
2 Chisels, handled and sharpened, ½ and 1 in.
1 Combination pliers, 6 in.
1 Try square, 6 in.
1 Rule, folding, 2 ft.
1 India oilstone, iron box
1 Double-ender saw file, handled, 8 in.

Additional tools that will make this outfit more complete for the home carpenter are:

1 Ripsaw, 26 in.
1 Nail set
1 Monkey-wrench, 10 in.
1 Compass saw, 12 in.
1 Hacksaw frame, 8 in., with blades
1 Chisel, ¼ in.
1 Auger bit, ¾ in.
1 Smooth plane, iron, or 1 jack plane
1 Oilcan
1 Carpenter's pincers, 10 in.
1 Cold chisel, ⅝ in.
1 Steel square, 16 by 24 in.
1 Adjustable level, 22 in.

It will pay occasionally to buy a special tool for certain work, such as a shingling hatchet for shingling.

For the home worker who is more interested in furniture making and cabinet work, a somewhat different selection is advisable. A good assortment for him would be as follows:

1 Crosscut saw, 24 in., 10 points to the inch
1 Ripsaw, 24 or 26 in.
1 Backsaw, 10 in.
1 Fret or coping saw frame and blades
1 Adze-eye nail hammer, 1 lb.
2 Screwdrivers, 4 and 6 in.
1 Nail set
4 Auger bits, ¼, ⅜, ½, and 1 in.
3 Gimlet bits, 1/16, ⅛, and 3/16 in.
1 Screwdriver bit, ⅜ in.
1 Rose countersink, ½ in.
1 Handled bradawl, 1⅜ in.
1 Square reamer
1 Jack plane, iron
1 Smooth plane, iron
1 Block plane, iron
1 Spokeshave, iron, 1¾ in. cut
4 Chisels, handled and sharpened, ⅛, ¼, ½, and 1 in.
1 Gouge, handled and sharpened, ⅜ in.
1 Cabinet scraper and burnisher
1 Combination pliers, 6 in.
1 Double-ender saw file, handled, 8 in.
1 Flat bastard file, 8 in.
1 Half-round bastard file, 10 in.
1 Try square, 6 in.
1 Marking gage
1 Sliding T-bevel
1 Rule, folding, 2 ft.
1 India oilstone, iron box
1 Oilcan

(*Continued on page 87*)

SHOOTING white water, or lazily gliding through shadowy reflections, an "Old Town Canoe" answers every pressure of the paddle. An "Old Town" is speedier, steadier, and gives years more of rugged service.

"Old Towns" are the lightest and strongest canoes made. For they are patterned after the old-time Indian models. And they are built by expert "Old Town" craftsmen. Every "Old Town Canoe" is built on Indian speed-lines. They are the lowest priced canoes made. $54. up from dealer or factory.

Write for profusely illustrated new catalog. Leading models shown in full color. Free.

OLD TOWN CANOE CO.
1294 Main Street, Old Town, Maine, U. S. A.

"Old Town Canoes"

MAKE YOUR FORD INTO THIS SPORT CAR Patterns Life Size

Red-i-Kut $6.40

Other types down to $3.50. Life size patterns and simple instructions show all details. Materials from hardware store and spare time work complete job at quarter factory cost. Order NOW from this ad. Illustrated prospectus showing bodies, tops, windshields mailed for 5c coin.

Keen, Classy Up to the minute

KUEMPEL CO., 86 KUEMPEL BLDG., GUTTENBERG, IOWA

SHELTER TENT $1.45

Made of olive drab, 10 oz. waterproof canvas. Easily packed and carried, being in 2 sections which tightly fasten together with double buttons. Folds into compact bundle weighing approx. 7 lbs. Size 7 ft. x 4 ft. 6 in. Sold as high as $10.00. Our 30 Day Anniversary Sale price $1.45, plus 60c for packing and postage. *Satisfaction guaranteed.*

ATLANTIC STORES
213 Koplin Bldg. Atlanta, Ga.

Why Good Dancers Are Popular

Everyone admires and wants to dance with the person who knows the latest steps. No need to envy good dancers who are popular and sought after in every social gathering. Arthur Murray, dancing teacher to the Vanderbilts, has invented a remarkable new method which enables *anyone* to learn all the newest dances at home—in private, in *only a few hours*. Even a child can learn by this fascinating, easy method. You need no music or partner. More than 60,000 people have learned dancing by mail. Mr. Murray's instructions are guaranteed to be *easier* than that of a personal teacher. You can learn the Fox Trot, Waltz, Conversation Walk and other new dances at a fraction of the cost of personal lessons.

FREE DANCING LESSON

To prove that Arthur Murray's remarkably simple picture method will make you an accomplished, confident dancer *easily* and *quickly*, we will send you, in plain cover, a sample dancing lesson without charge. No obligation. For mailing send 10c. Will you write today?

Arthur Murray School of Dancing, Studio 145, 290 Broadway, N. Y.

"Lighting Fixtures"

Ready to hang.
Direct from manufacturers.
Completely wired including glassware.

Send for Catalogue No. 24 and Dealers' proposition

ERIE FIXTURE SUPPLY CO.
Desk A, Erie, Pa.

Tools that Will Make Your Home Complete

(*Continued from page 86*)

To make the set as complete as the amateur woodworker is apt to need, these tools may be added:

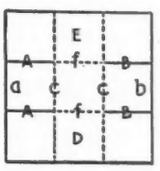
1 Compass saw, 10 in.
1 Riveting hammer
1 Round lignum-vitae mallet
1 Screwdriver, 2½ in.
1 Hand drill and drills
4 Auger bits, 5/16, 7/16, 9/16, and ¾ in.
1 Expansive bit, ⅞ to 3 in.
1 Jointer plane, iron
1 Rabbet and filletster plane, iron
1 Double-end match plane
1 Adjustable chamfer plane
1 Cabinetmaker's scraper plane
1 Edge-trimming block plane
3 Chisels, handled and sharpened, ⅜, ⅝, and ¾ in.
2 Gouges, ½ and ¾ in.
1 Sloyd knife
1 Winged divider, 6 in.
1 Flat-nose pliers, 5½ in.
1 Round-nose pliers, 5½ in.
1 Pipe wrench, 10 in.
1 Tinner's snips, 10 in.
1 Set bit-stock drills, ⅛, 1/32, 3/16, 7/32, ¼, 5/16, and ⅜ in., for metal
2 Handled round bastard files, 6 and 8 in.
1 Handled cabinet file, 8 in.
1 Handled cabinet rasp, 8 in.
1 Adjustable level, 22 in.
1 Combination miter box
1 Brass plumb-bob with linen line
1 Glass-cutter
1 Bench duster
1 Scratch awl
1 Knurled center punch
1 Tool grinder, 5 by 1 in. wheel

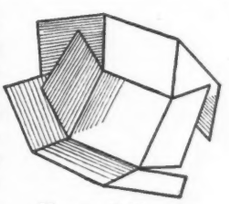
This equipment would be more than the average cabinetmaker has at his disposal, but, of course, the amateur really needs more tools, since he usually has not the advantage of woodworking machinery or even the modern small bench machines, particularly saws and hand planers, which are used in up-to-date cabinet shops.

The ideal home workshop woodworking bench, vises, clamps, and small machines such as lathes and scrollsaws, will be left for discussion at another time.—HOME WORKSHOP EDITOR.

Starting Boxes Made from Berry Baskets and Wrapping Paper

BY using berry baskets and heavy wrapping paper to start my plants in, I had a vegetable and flower garden from ten days to two weeks before my neighbors, and, as any one who has lived in a gardening community knows, that is an accomplishment to be proud of. I was able to transplant beans, corn, melon, squash, and many other vegetables and flowers into the open ground after danger of frost without disturbing the root growth. By wetting thoroughly, no time was lost in getting them started in the garden.





How to fold paper

The paper should be cut large enough to cover the bottom and to come to the top edge of the sides of the boxes. Place the basket in the center of the paper, cut slits as marked in the diagram *A* and *B*, and fold on the dotted lines so that *A*, *B*, *D*, and *E* will form the sides for containing the earth and fertilizer. Every gardening enthusiast will find these boxes a great boon.—C. C. RICH.

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THE HOME WORKSHOP

Making Merry *with* Marionettes

How to Give Amusing Puppet Plays at Home

ONE of the most fascinating and instructive indoor entertainments for children is the giving of marionette shows. Few amusements will provide more lasting pleasure for them, and the "grown-ups" will get just as much fun out of it.

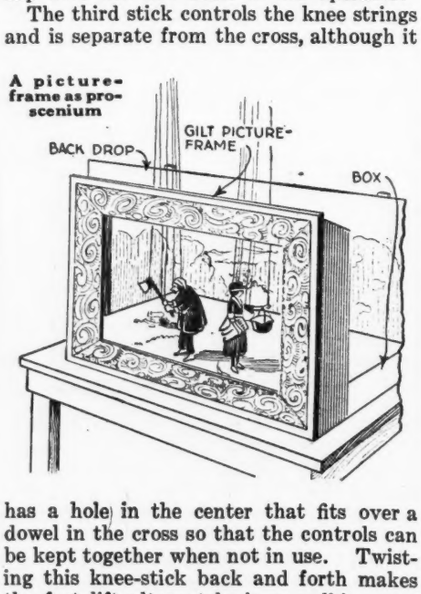
Rag dolls, about 7 in. high, such as can be bought cheaply at any toy-store, are all that are necessary for homemade marionettes. They will be too stiff, of course, but loosen up their joints at the neck, elbows, and knees by taking out the stuffing and sewing them so that they will be as flexible as if held by a single thread.

"Professional" puppets, such as Mr. Tony Sarg makes, are cut in two at the waistline and have a short section of stocking inserted to form a hollow waist, but for home entertainments one does not have to be so particular.

A string is attached to each wrist and knee, two strings to the head, one at each ear, and one string to the middle of the back. Other strings can be added for special actions, as the puppeteers become expert. Strong, black linen thread should be used for the strings.

To help control the puppet strings, Mr. Sarg has devised a special "controller" made of three pieces of wood. One is about 1 ft. long and another 9 in., forming a cross, as shown, with a strap over the joint to slip over the left hand of the operator.

The third stick controls the knee strings and is separate from the cross, although it



has a hole in the center that fits over a dowel in the cross so that the controls can be kept together when not in use. Twisting this knee-stick back and forth makes the feet lift alternately in a walking motion, the main "controller" being moved forward at the same time. This stick can

(*Continued on page 89*)

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THE HOME WORKSHOP

(Concluded from page 88)

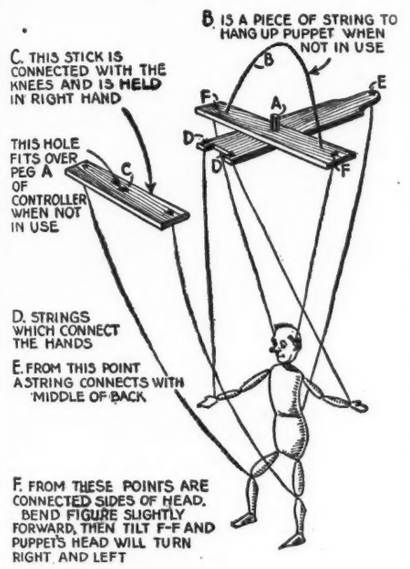
be placed on the cross when leg motions are not necessary. The operator then has his right hand free to move other strings.

The marionettes must be costumed in bright and harmonious colors to suit the parts they are to play, and, if desired, character heads may be modeled for them from modeling-wax. These heads may be made durable by covering them with fine, glue-soaked gauze, which forms a hard surface that can be painted.

Among the most charming puppets are animal toys—dogs, bears, lions, rabbits—controlled in a similar fashion to the dolls.

A stage may be made in a double doorway, if available, or a simple one may be constructed on a plain, heavy kitchen table or bench. The accompanying illustrations suggest the possibilities.

An old gilt picture-frame with elaborate moldings makes an ideal proscenium arch, but a large sheet of cardboard with an opening about 18 by 24 in. will serve well, especially if it is decorated in imitation of a regular theater proscenium. The back-


B. IS A PIECE OF STRING TO HANG UP PUPPET WHEN NOT IN USE
C. THIS STICK IS CONNECTED WITH THE KNEES AND IS HELD IN RIGHT HAND
THIS HOLE FITS OVER PEG A OF CONTROLLER WHEN NOT IN USE
D. STRINGS WHICH CONNECT THE HANDS
E. FROM THIS POINT A STRING CONNECTS WITH MIDDLE OF BACK
F. FROM THESE POINTS ARE CONNECTED SIDES OF HEAD. BEND FIGURE SLIGHTLY FORWARD, THEN TILT F-F AND PUPPET'S HEAD WILL TURN RIGHT AND LEFT

The "controller" and string connections

drop may also be of cardboard, plain gray on one side for interior scenes and blue on the other for outdoor scenes, or it can be decorated as elaborately as time and skill permit. Decorations of colored paper pasted on will be found most effective.

When a play is being given, the room should be in darkness and the stage lighted, if possible, by a portable electric reading-lamp, shining directly on the stage. Blue and red silk will modify the light for moonlight and firelight scenes.

The curtain should be arranged to pull aside or to drop and should work freely, so that it can be closed or dropped instantly in case the puppet strings become tangled.

In giving a show, each child has a character to manipulate and other children speak the parts unless a grown person reads all the lines. Music for songs and dances can be provided and tickets and programs issued in real "grown-up" style.

These secrets of how to make and manipulate marionettes have been revealed by that king of marionette-makers, Tony Sarg, in his new book, "The Tony Sarg Marionette Book" (B. W. Huebsch, Inc., New York), which also contains two exceptionally good plays for homemade marionettes.

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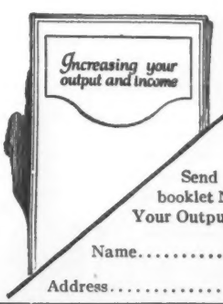

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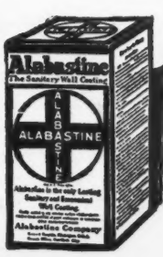

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The Shipshape Home

How to Do Those Odd Jobs

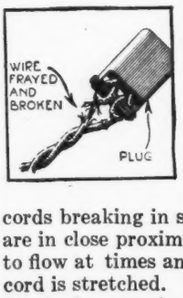
Electrical Appliances

NEARLY every home these days has electrical appliances of one sort or another, which in the course of time require repair. This article will outline briefly some of the more important troubles that the average householder can remedy at a fraction of the cost of having the same work done at a repair-shop, to say nothing of the time saved.

Perhaps the most frequent source of trouble is the electric cord, which should be examined immediately if the appliance fails to heat or run properly. Very often, especially with electric flatirons, several of the wires in the cord become frayed or broken because of continual bending and twisting while in use. This usually occurs close to the plug that fits over the two contacts on the iron.

The current-carrying capacity of the wire becomes reduced, with the result that it is but a short time before the wire is completely burned through and the circuit is dead.

Occasionally an unusual pull on the core tears loose one of the leads from its terminal. The remedy is to dismantle one or both plugs and then either shorten the cord to cut out the break or refasten the loosened end.



Sometimes an appliance will show signs alternately of being dead and heating. This is probably due to the cords breaking in such a way that the ends are in close proximity, allowing the current to flow at times and stopping it when the cord is stretched. This, if near a plug, is repaired as previously described.

Should there be a break at some distance from the plug, it is best also to cut the other wire to insure both wires being equal in length. Then bare the ends for a short distance, twist them firmly together, and tape the joints. A break of this kind can often be detected by the simple procedure of bending the cord between the fingers a little at a time.

Cleaning Contacts

VERY often the frequent pulling loose of the plug from the appliance and the consequent arcing of the current causes the contacts on the appliance and the clips in the plug to become oxidized. In time this may introduce so much resistance in the circuit that the appliance either fails to heat properly or else fails altogether. The remedy is to use a small flat file to bring the contact surfaces down to clean metal.

These contacts are of substantial design for the purpose of breaking the heavy current used. Never turn off the appliance at the socket, as this practice will soon burn out the contacts.

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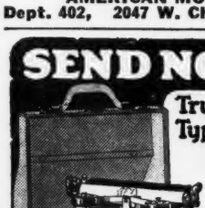

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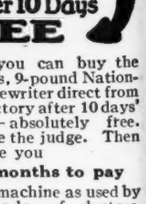

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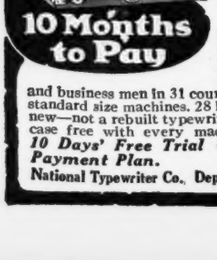

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National Typewriter Co., Dept. 20-D, Fond du Lac, Wis.

THE HOME WORKSHOP

The Shipshape Home

(Continued from page 90)

Repairing Elements

ANOTHER frequent source of trouble is the burning out of the element. If complete, this damage is best taken care of at the repair-shop. In a majority of cases, however, the element is nothing more nor less than a special resistance wire wound in a coil, and many times it will burn through at but one point.

Since soft solder will not stand the intense heat to which the element is subjected, the only remedy is silver soldering, which is not so difficult as one may think. It necessitates the purchase of a small alcohol blowtorch, a very small bit of silver solder, and a small amount of borax. I believe it safe to say that the cost of these articles will be covered by the saving made on the first repair job.

Running a piece of sand- or emery-paper back and forth between the successive coils on each of the broken ends will serve to brighten up and remove some of the oxide from the wire. Stretch the two ends slightly so that they are interlaced for perhaps ¼ in., thereby bringing clean surfaces of the two ends into contact. The element, if possible, should be supported so as to bring the splice away from contact with the insulated support. Otherwise the heat may be conducted away from the element so rapidly that it will be difficult to bring it to the proper temperature.

Silver Soldering

A LITTLE borax should be sprinkled over the splice, a small piece of silver solder placed in position, and the flame brought to bear. It should take but a moment to bring the element to a bright red heat, and if the surfaces have been properly cleaned, the silver solder should readily fuse to the two ends, making a perfect joint.

Occasionally the element may be in perfect condition except for the rather delicate leads from the element to the terminal contacts. They may be broken or burned through. This often may be remedied by silver soldering brass strips to the element to act as leads.

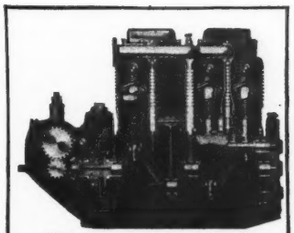
Vacuum Cleaners

Now and then a vacuum cleaner will either fail to run properly or perhaps will not run at all. As previously suggested, the cord should first be examined. Perhaps the bearings need oil.

Sometimes lint, threads, and dust get in back of the fan around the shaft and prevent it from turning. This may be determined by removing the motor housing. If the trouble is not there, look at the brushes. Dust and oil may have gathered between the brushes and their holders, thereby holding the brushes back and preventing the springs from forcing them into contact with the commutator. Removing the grease and dirt will probably solve the problem. If the armature is burned out there is no recourse but to have it rewound or buy a new one.

A New Thrill— A New Pleasure

The Ace Four-Cylinder Motorcycle brings to you an entirely new idea of motorcycle transportation



This cross-section drawing shows the remarkable, refined design of the Ace four-cylinder motor. An exclusive pre-heating device prepares the fuel for perfect combustion; large valves insure ample gas and air supply and provide for quick, complete expulsion of exhaust gases from the cylinders; compact combustion chamber's with spark plugs firing in center of fresh gas give snappy ignition; precision-ground cylinders and pistons insure maximum compression; large sized, case-hardened, three-bearing crank shaft ground to glass smooth surface minimizes friction; long connecting rods reduce the angularity of thrust, adding wonderfully to the driving power.

SMOOTHNESS that you have never imagined, silence that you have never dreamt of and comfort that has never before been possible in a motorcycle belong to the owners of the Ace four-cylinder motorcycle.

A steady flow of great power and silent vibrationless action come from Ace perfected four-cylinder construction. The real thrill of flying, sweeping motion is yours the moment you mount this new Master of the Highway. Instant pick-up at a twist of the wrist—comfort, safety and speed that give you a new control over time and distance.

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ACE

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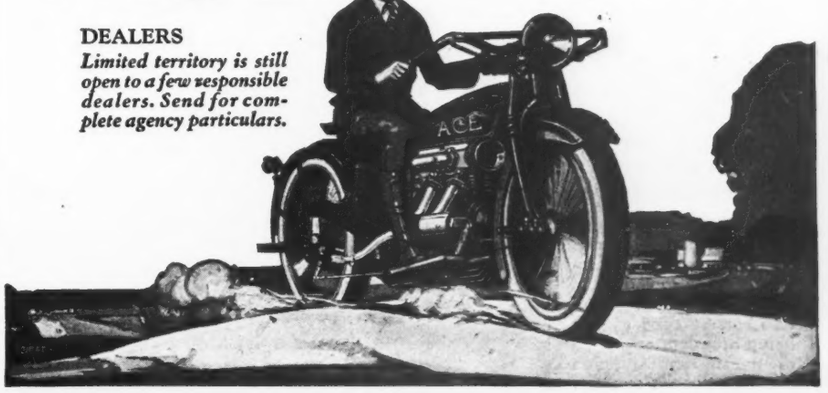

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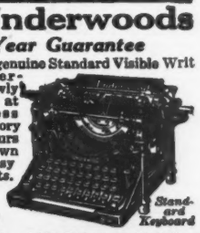

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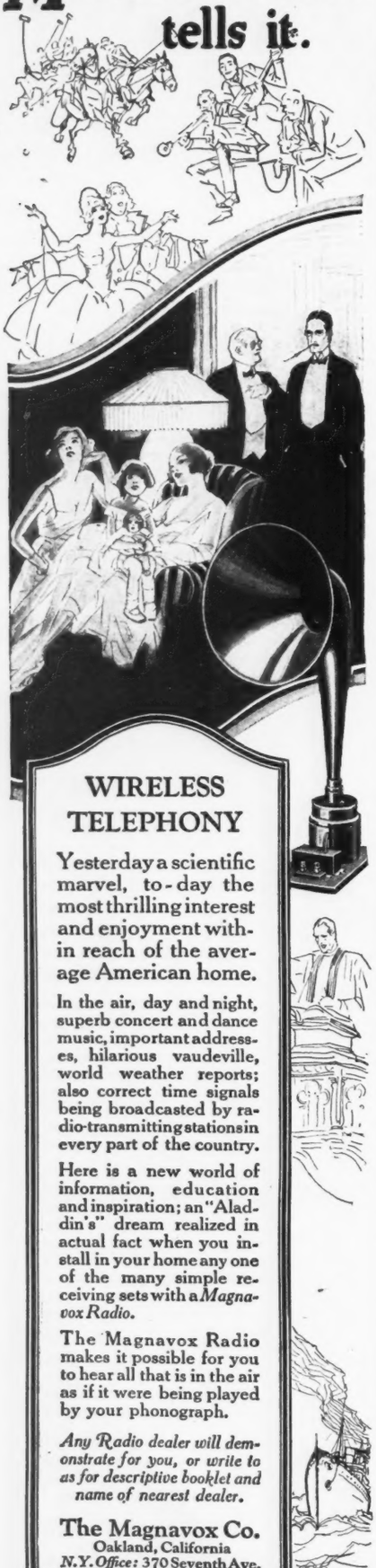
Radio brings it, MAGNAVOX tells it.



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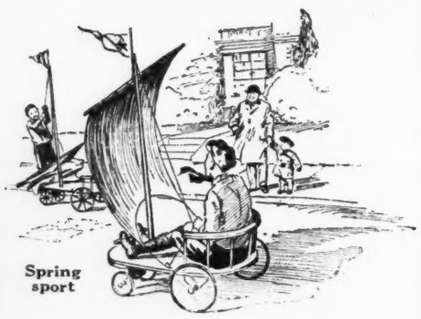
THE HOME WORKSHOP

To "Sail" This Wagon, Harness the Wind

TO make this sail wagon a board about 3 ft. 6 in. in length, 18 in. wide, and ⅞ in. thick is cut into a shape something like an ironing-board, narrower at one end than at the other. Another ⅞-in. piece of board is secured to the front end to give strength for the mast and steering-gear.

One pair of large and one pair of small wheels are necessary. The large wheels and axle can be fastened to the bottom board by means of two blocks of wood.

The two small wheels must be rigged up a little differently. A board about the same thickness as the axle is shaped round



Spring sport

at one end to fit loosely into a hole bored in the front end of the wagon. The broad end of this board rests on the axle, and is bolted to two pieces of board the same width, which come down on the front and rear sides of the axle and are bolted to it. The bearing is made of tough wood and placed so that the front wheels turn easily. A round stick is put through the stem of the steering-rod for steering with the feet.

The mast can be made from a round stick about 4 ft. 6 in. long. A broom-handle will do for the cross arm, to which the sail is attached. The sail should be so arranged that it can be lowered very quickly should the wind get the best of the wagon. This can be done either by having a small pulley at the masthead, through which is passed a rope for raising and lowering the sail, or the end of the sail can be loosened and allowed to fly.

Smooth roads, an open space, and plenty of wind are all that are necessary for a successful sail-wagon race.—R. H. NEIL.

When to Spray Fruit-Trees

THE codling moth, which is the worst insect enemy of orchard fruits, can be most successfully combated by spraying if the fruit-grower knows the exact time when the horde of newly hatched worms will be out in force to attack his orchard.

That can be determined very accurately by a simple method. A small piece of ordinary window-screen is rolled into a cone-shaped cage and suspended in an apple-tree. A number of cocoons of the moth are collected in the spring and placed within the suspended cage, where they are subjected to natural conditions. The orchardist watches daily for the maximum emergence of the moths, and, knowing that their eggs will hatch about seven days after they are laid, can have his trees sprayed with a poisonous insecticide just in time.

This is far better than relying on spraying calendars, because the life cycle of the codling moth is variable, differing in various localities.—WILLIAM P. HAYES.

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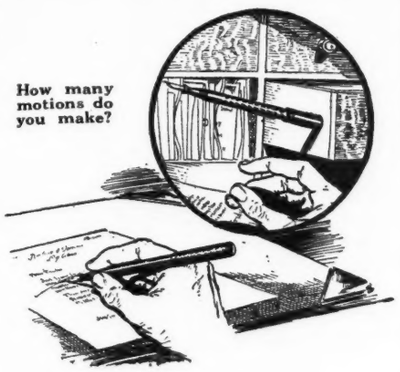
THE HOME WORKSHOP

Engineer's Analysis of Motion Suggests New Pen-Rack

MUCH time is lost daily by the average person who handles pens and pencils in writing, figuring, signing names, and the like. This is due to the fact that the pencil or pen is laid down more or less carelessly and upon being picked up again, must be handled by both hands before it is properly adjusted to the writing position. Each and every writer has a writing position peculiarly his own.

The writer has hit upon a method that saves most of this time. A hole was bored



in one of the small drawers of my rolltop desk at the angle indicated in the accompanying sketch. The base of the penholder fits loosely into this hole at the proper angle.

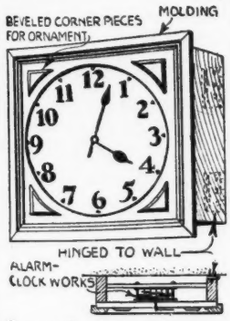
After finishing with the pen, it is placed in this hole without altering the position of the fingers at all. It is therefore always in the correct position, ready to be grasped without any loss of time and without any adjusting.

This idea is based upon motion-study methods. Ten or more motions are here reduced to two. I have not applied it to lead-pencils because I do not often use them.—N. G. NEAR.

Converting an Alarm-Clock into a Large Timepiece

A LARGE clock that will give reliable service in the factory, office, or schoolroom can be made at small cost by using the works of an ordinary alarm-clock.

A wooden case is made of any desired design and a dial is cut from a good grade of bristol board on which the hours are lettered neatly and accurately with black ink. Hands to suit the dial are cut from sheet aluminum or other light material.



Camouflaging an alarm-clock

The works from an alarm-clock are removed from their metal casing and are mounted centrally in the box upon cross-bars. Either the whole box or the dial frame is hinged so as to permit winding.

With a little care in workmanship the large clock can be made to look as well as the ordinary type of clock.—JOHN M. PIPP.

Evinrude Outings No. 1
The best bathing places are always near at hand when you have an Evinrude

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Sparkling water, a shady nook on shore, care-free companions,—and an **Evinrude** to motorize your rowboat. Can you think of a happier setting for a wonderful day in the open?

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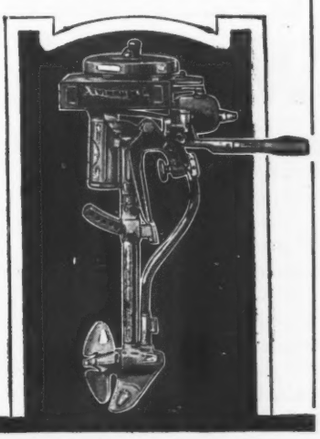
Both Evinrude models, Standard and Lightweight, are practically the same in design, size, power and speed. Due to the judicious use of aluminum alloys, the Lightweight scales just under 50 pounds, complete—easily carried with you in car, train or trolley.



See these Evinrude motors at your sporting goods or hardware dealer's. Or write for catalog and new prices (recently cut to pre-war level).

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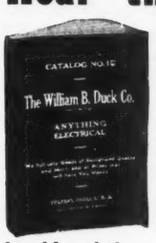

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Radio Sets Cost Very Little

Complete sets sell for as little as $20—some even less. Today there are thousands bringing into their homes music, concerts and news hundreds of miles away, and with a loud speaker to replace the receivers on the ears, the entire family may clearly and distinctly enjoy the entertainment.

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With Johnson's Wood Dye inexpensive soft woods, such as pine, cypress, fir, etc., may be finished so they are as beautiful and artistic as hardwood. Johnson's Wood Dye is very easy to apply—it goes on easily and quickly, without a lap or a streak. It penetrates deeply, bringing out the beauty of the grain without raising it—dries in 4 hours and does not rub off or smudge.

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A Home Workshop Blueprint Will Give You the Full-Sized Details of This Neat and Useful End Table and Book Trough

WOULD you like to own the end table and book trough illustrated in the accompanying drawing? If you would, you can make it with little difficulty from the complete working details in blueprint No. 3, prepared by the Home Workshop Service Department.

Books can be kept handy in the trough, leaving the top of the table clear for other things

The table stands 2 ft. 6 in. high and the top is 2 ft. 3 in. long and 13 in. wide. The ends, in which the chief charm of the table's appearance lie, have been carefully designed to combine delicacy and grace with the utmost stability, so that there is no danger of tipping. This permits carrying the book trough high, compared with many other designs for similar pieces of furniture, and the books are, therefore, more conveniently within reach.

In harmony with the legs, the top is shaped at both ends in delicate curves and the edges are lightened by being simply molded. The home craftsman can, of course, substitute a plain top, if he so desires, and omit the molded edge, or bead it, or treat it in any other way that suggests itself to him.

The edges of the book trough are treated in a way somewhat similar to the top, in order to harmonize with it. The trough is housed solidly into the ends.

The stretchers, or foot rails, are set edge up, so that there will be no danger of their sagging. They have long tennons which pass through mortises in the ends and are fastened with small, neat wedges that conform to the general design.

The table may be made of quartered oak, plain oak, chestnut, white pine, or whitewood. At a little additional expense, mahogany may be used. The utmost pains should be taken with finishing, for, while good finishing will not conceal bad workmanship, in so simple a piece as this much depends upon the success with which it is finished.

If an open grain wood is used, it should be stained, filled with paste filler, shellacked, and finally varnished. Those who have had little experience in applying shellac, can obtain a good looking finish by using one of the commercial varnish stains, or a paste or liquid wax finish.

For the home worker who has a fretsaw or access to one, or to a band or jigsaw, this problem will be simplicity itself.

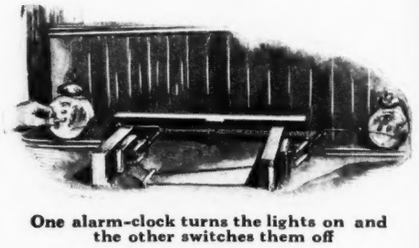
Blueprints of this and the preceding Home Workshop designs, on sheets 15 by 22 in., may be obtained for 25 cents each.

Next month's blueprint will contain the details of a white-enameled kitchen cabinet that can be made without difficulty in the home workshop.

Turning Store-Window Lights On and Off Automatically

FOR more than three years I have used the device shown in the accompanying illustration to turn on and off my store-window lights, and it has proved very very reliable.

The alarm-clock on the right is set so as to ring when I wish the lights to go on.



One alarm-clock turns the lights on and the other switches them off

The alarm winding key has soldered to it a small wire crank, which revolves with the key when the alarm goes off. This crank strikes a lever pivoted on a screw and trips it, thereby releasing the switch, which is pulled closed by the spiral spring.

At 11 P.M., when I wish the lights to be turned off, the alarm-clock shown at the left rings and a similar crank on its alarm winding key trips another lever and permits the second switch to be pulled open, thus breaking the circuit. The levers are made of ⅛-in. wire.—FRANK A. HAMELIN.

Please Use This Coupon for Ordering Blueprints from the Home Workshop Service Department

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No. 1	Sewing-Table	25 cents	No. 3	End-Table with Book-Trough	25 cents
No. 2	Smoking Cabinet	25 cents	No. 4	30 ft. Monoplane Glider, 2 sheets	50 cents

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City and State.....

THE HOME WORKSHOP

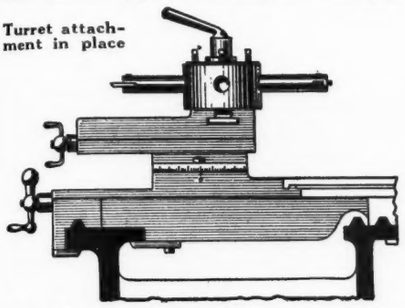
Turret Attachment Converts Engine Lathe into Efficient Production Machine

By Joe V. Romig

("Best Idea" First Prize for April)

THIS attachment, built by the writer for production work, converts a common 16- or 18-in. lathe into a turret lathe. The job for which these turrets were built was the machining of pipe flanges. We were able to bore, thread, chamfer, and face the flanges all at one setting. In fact, on duplicate work, these turrets will pay for their making in a few days of actual use.

The swivel head is designed to hold bars with shanks 1¼ in. in diameter. The bars

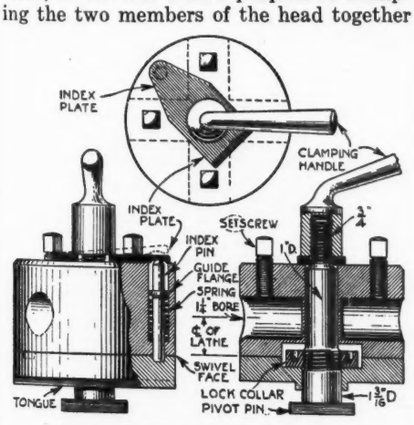


Turret attachment in place

can be long or short and fitted up for facing, turning, boring, bottoming, etc.

The base and the head are made of 5 in. diameter steel shafting, turned as shown by the accompanying details. The lower member is shaped on its bottom face with a tongue, which should be a neat fit in the slot of the compound rest. The upper head is bored and reamed to fit the pivot pin or spindle. Then both members are counterbored to provide room for the locking collar, which screws on the threaded portion of the spindle and clamps the base firmly to the rest. The bottom of the spindle is squared off to fit the slot in the compound rest.

The bent clamping lever, of conventional form, serves the double purpose of clamping the two members of the head together



Details of turret and indexing plate

and permitting quick adjustment by means of the indexing pin. This pin rises and clears the base through the action of the inserted spring when the clamping lever is unscrewed and the index plate rises. That allows the head to be turned to its next position, and the lever is retightened.

When drilling the indexing holes in the base, drill one set of holes for a 90-degree setting of the compound rest, and another set for the 30-degree setting used in threading. After the holes are drilled, they should be carefully reamed and fitted with the tool-steel index pin, which is slightly tapered at its lower end.

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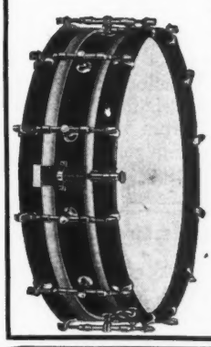

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Can be purchased at all radio, electrical or department stores. If your dealer is not supplied as yet, send money order or check direct for immediate shipment.

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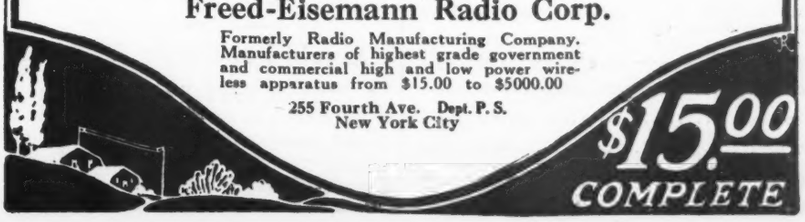

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I will not accept a single penny of your money until you are satisfied and tell me so. Simply fill in and mail the coupon below, giving me the simple easy information I ask for and I will send you a pair of my Extra Large Tortoise Shell Spectacles for you to wear, examine and inspect, for ten days, in your own home. The glasses I send are not to be compared with any you have ever seen advertised. They are equal to spectacles being sold at retail at from $12.00 to $15.00 a pair. You will find them so scientifically ground as to enable you to see far or near, do the finest kind of work or read the very smallest print. These Extra Large Size Lenses, with Tortoise Shell Rims, are very becoming and your friends are sure to compliment you on your improved appearance. There are no "ifs" or "ands" about my liberal offer. I trust you absolutely. You are the sole judge. If they do not give you more real satisfaction than any glasses you have ever worn, you are not out a single penny. I ask you, could any offer be fairer?

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If you send your order at once I will make you a present of a handsome Velveteen Lined, Spring Back, Pocket Book Spectacle Case which you will be proud to own. Sign and mail the coupon NOW. Dr. Ritholz, Madison & Laflin Sts., Station C, Chicago, Ill., Doctor of Optics, Member American Optical Association, Illinois State Society of Optometrists, Graduate Illinois College of Ophthalmology and Otology, Famous Eye Strain Specialist.

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You may send me by prepaid parcel post a pair of your Extra Large Tortoise Shell Gold Filled Spectacles. I will wear them 10 days and if convinced that they are equal to any glasses selling at $15.00, I will send you $4.49. Otherwise I will return them and there will be no charge.

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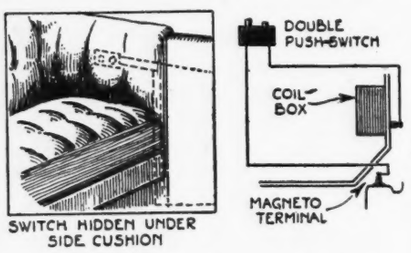
Switch Concealed in Upholstery Foils Ford Thief

EIGHT feet of high tension wire, a two-button boxed-in wall switch and a small quantity of tape, will defeat any thief who tries to steal a Ford, even if he carries an extra coil-box with the necessary wires to hang it on the manifold pipe.

The sketch shows the method of wiring. The switch is placed somewhere under the upholstery. Be sure the switch is completely insulated.

Arrange the wiring so that the wire from the magneto terminal to the switch is taped



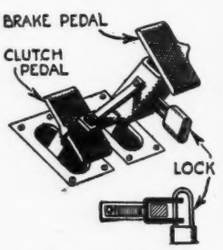
Wiring diagram and method of hiding thief-detecting switch

to the wire running back from the switch to the coil-box at a point as close as possible to the magneto terminal. In that way a hurried or casual examination of the magneto wire from the engine side will give the appearance of correct wiring from magneto to coil-box. This method can easily be used on the starter type of Ford by breaking in on the battery wire.

This device has already foiled an attempt to rewire a lock that was pried off, and has also prevented children from starting the car when the keys were inadvertently left in the lock.—H. M. EMMONS.

An Automobile Clutch Lock

AN effective clutch lock consists of a steel or iron sleeve and arm formed as shown in the accompanying illustration. It fits snugly over the pedal brake and is put in place after the clutch pedal has been pushed down. The arm on the locking device keeps the clutch pedal down so that the car cannot be operated. Thieves would have either to smash the padlock that secures the locking device on the brake pedal, or tow the car away.



Sturdy and foolproof

The main channel-shaped part of the lock is about 4 in. long for standard cars. It may be provided with two or even three pairs of holes so that two or three padlocks may be used, if it is desired to take particular precautions against the car's being tampered with.—R. C. L.

Liquid Powder for Golf Balls

A SOILED golf ball can be made as good as new, it is said, by coating it with liquid face-powder. This makes a white coating that will stick on for at least one round.—PETER H. HEINZ.

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If you want to save 25% to 50% on fuel and repair bills, be rid of missing cylinders dirty plugs and carbon, have a quick start and pep on hills, write the Warren Mfg. Co., 271 Gray Bldg., Kansas City, Mo., and a set of Warren Transformers will be sent immediately, with the understanding that they do not cost you a cent if not entirely satisfactory.

So confident is the Warren Mfg. Co. that Warren Transformers will more than delight you that they offer to send a $4 set for only $2. This is a special introductory offer, good for only a few days, and readers should take advantage of it immediately.

Send No Money with your order—just your name and address, name of car and number of cylinders. Warren Transformers will be sent immediately. When they arrive merely pay the postman $2 and postage. Use them 10 days. If not satisfactory return and your money will be refunded. Write today. End your motor troubles. This offer fully guaranteed.

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THE HOME WORKSHOP

Build a Stanch Ten-Foot Rowboat at Small Cost

By C. S. Taylor

BOATS are not difficult to build for any one who can saw a board and drive a nail properly and is willing to carry on the work slowly and carefully, following the drawings. The boat illustrated is a good model, rows easily and tows well behind a motor-boat. It is a good all-around rowboat and can be built as cheaply as it is possible to construct a serviceable, tight,

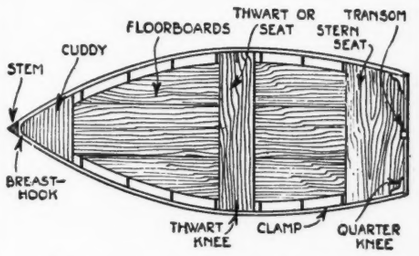

Fig. 1. Plan showing rowboat parts

and safe boat of small size. The dimensions are: length, 10 ft.; beam (width), 4 ft.; depth forward, 2 ft. 1 in.; depth at stern, 1 ft. 4 in.

Keel, oak, 9 ft. long, 1½ in. square.
Frames or timbers, 18 pieces, oak, 1½ ft. by ¾ in. by ½ in.
Planking, cedar, cypress, or pine, 6 planks, 11 ft. long, 20 in. wide, ½ in. thick.
Stem, oak, 2 ft. long, 1½ in. thick.
Stern post, oak, 1½ ft. long, 2 in. wide, 1 in. thick.
Floorboards, cypress, cedar, or pine, ½ in. thick, 20 ft. board measure.
Seats, oak or cypress, ⅞ in. thick, 10 ft. board measure.
Clamp, oak, 2 pieces, 11 ft. long, 1 in. wide, ¾ in. thick.
Bilge stringer, spruce, cypress, or pine, 2 pieces, 11 ft. long, 1¼ in. wide, ¼ in. thick.
Breast hook, oak, 9 by 6 in., 1 in. thick.
Quarter knees, 2 pieces, oak, 6 in. square, 1 in. thick.
Keel batten, cypress, cedar or pine, 9 ft. long, 2½ in. wide, ⅞ in. thick.
Stern transom, oak, ¾ in. thick.
Floor timbers, pine or cypress, 9 pieces, by 4 ft. 3 in. by ⅞ in. thick.

This is all the material required to build the boat. Its cost will depend upon the locality. By taking the list to two or more dealers and placing the order with the lowest bidder, the boat should not cost more than from $8 to $12 for lumber.

As the boat is small, it may be built in the attic and lowered from the window or constructed in the cellar, shed, or any place

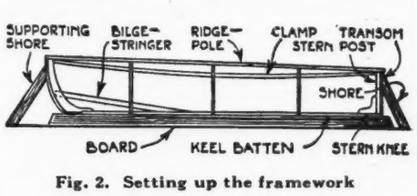

Fig. 2. Setting up the framework

that is dry. It can be built outside if a canvas roofing is put up to keep off the rain.

The first step is to cut out all the material to the dimensions given. The best way to set up the boat is to fasten it to a board and prop up the board as shown in Fig. 2. Be sure the keel is perfectly straight and level, then fasten on the stem with rivets or galvanized boat nails, first boring holes a trifle smaller than the nail to prevent splitting the wood. Then set up the stern post, transom, and stern knee. The ridge pole may next be put on and the clamp fastened in place. Next put in the

(Continued on page 98)

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..Asthma	..Failing Hair	..Pimples and Blackheads
..Obesity	..Weak Eyes	
..Headache	..Bad Habits	
..Thinness	..Gastritis	..Lung Troubles
..Rupture	..Heart Weakness	
..Lumbago	..Poor Circulation	..Round Shoulders
..Neuritis	..Vitality Restored	..Increased Height
..Neuralgia	..Weaknesses (Specify)	..Stoop Shoulders
..Flat Chest	..Anemia	..Muscular Development
..Deformity (Describe)	..Impotency	..Successful Marriage
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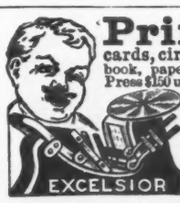

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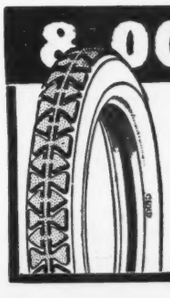

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THE HOME WORKSHOP

Building a Ten-Foot Rowboat

(*Continued from page 97*)

molds and the framework will be ready for the planking.

The molds are shown in Fig. 3 and may be made from any rough box lumber; they are used only to keep the boat in shape when planking it. Make them exactly according to the drawing and you will have no trouble. Set the molds up on the keel, perfectly plumb, and fasten them securely in place by driving a nail through the ridge pole, which should run across the molds exactly in the center and directly over the keel.

When the boat is securely shored up, fasten one end of the bilge stringer in the stem, as shown in Fig. 2, with a good sized brass screw, countersinking the head. Bend the stringer around the molds, fitting it in the notches, and screw it to the stern transom with a brass screw. Put in the other bilge stringer on the other side.

Placing the stringer may throw the molds out, of true but be sure to correct that as the work proceeds. Check up all this preliminary work carefully so that the boat may be true in shape from bow to stern before the planking is put on.

The side planks are in one piece. Smooth the board off, bend it around the top sides, and clamp it at the stem, molds, and stern with clamps or by nailing it lightly. Then

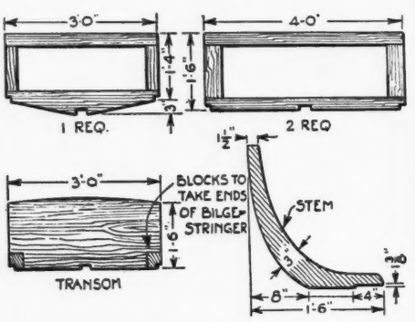

Fig. 3. Details of molds, transom, and stem

take a pencil and run it around the stem, molds, stern, and on the bottom of the bilge stringer. This gives the approximate shape that the side plank must be cut. Take the plank off, lay it down flat on the floor and bend a piece of thin wood to follow the penciled lines and draw a heavy line to this curve. The planking can now be sawed off along this line. Where the planking follows the stem curve, cut out a rabbet with a chisel to let in the planks and make a neat flush joint.

The bottom planking is best put on crossways of the boat. Turn the boat upside down and starting at the stern, put the first plank across the sides, the ends projecting slightly beyond the side planks, and flush with the stern transom. Nail with 1½ in. galvanized boat nails spaced about 1 in. apart. Now saw off the projecting ends of the plank flush with the side boards and proceed to put on the next plank. In putting on the planks, wedge the edges together as snugly as possible and paint the edges of the planks as you fasten them in place Proceed with the planking and finish at the bow.

The boat will be perfectly tight after it is allowed to swell up for a few hours after launching, and no calking should be needed. The edges of the bottom planking must, of

(*Continued on page 99*)

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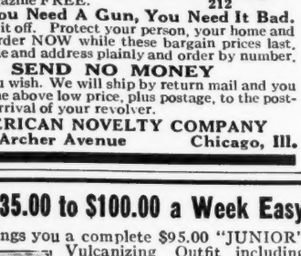

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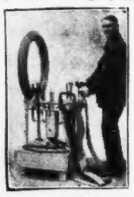

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THE HOME WORKSHOP

Building a Ten-Foot Rowboat

(*Continued from page 98*)

course, be planed true to make good joints that the wood may swell and force the planks tightly together.

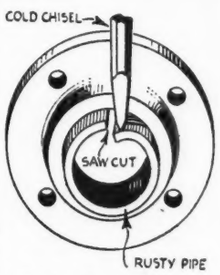
After the bottom planking is in place, the floorboards may be put in, first giving the bottom of the boat a coat of paint. The quarter knees go at each side of the stern transom and the seats are put in.

The boat is now finished, except for painting or varnishing. Any good house paint is perfectly satisfactory and any color desired may be used, thinning thick paint with pure turpentine only. A good color scheme is to paint the bottom and the sides emerald green for about 3 in., finishing the rest of the top sides in white or light gray. The inside of the boat looks well if painted a light buff color.

The painter or mooring line should be attached to the boat by boring a ½-in. hole through the oak stem, about 6 in. from the top. Do not fasten the rope to the cuddy seat as many do, but use the stronger manner suggested.

To Free a Flange Coupling from a Rusted Pipe

USUALLY it is not necessary to destroy a flange coupling, even if it becomes completely rusted on to a pipe. Saw the pipe off an inch or less from the coupling and cut through the part remaining in the coupling longitudinally with a hacksaw.

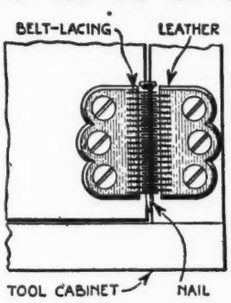


Saves flange from damage

Starting at the cut and using a cold chisel, drive the pipe inward until it has been freed from the threads of the coupling and can be removed without damaging them.—B. L. D.

A Wire Belt Splice Hinge

A LOCAL mechanic who did not have the necessary hinges for a cabinet, used pieces of a machine laced belt very successfully. An inch or two of the old belt was left attached to the wire lacing and the leather trimmed up with a sharp knife. Holes were drilled for wood screws.



A novel substitute hinge

These hinges work very smoothly and cost nothing, as nearly every machine-shop has some old splices lying around. — A. LA COUR.

Cutting Special Threads

SMALL left-hand or special taps for odd jobs are cheaply made by chasing a thread of the required pitch on a piece of drill rod in a lathe. The flutes are formed by filing the threaded portion three-cornerwise, giving the end a good taper for a starting.

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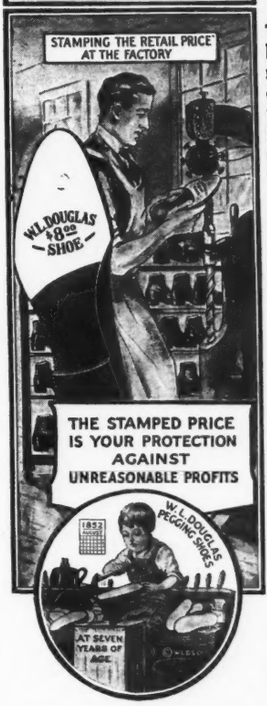
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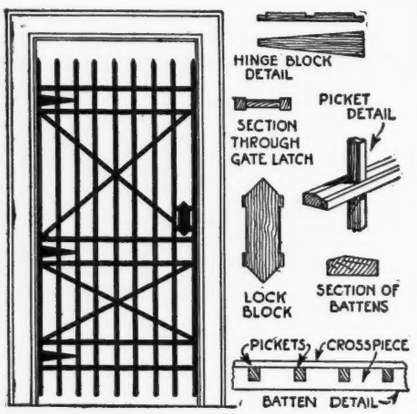
THE HOME WORKSHOP

Painted Hardwood Gate to Look Like Iron

IN constructing a gate such as is illustrated, which is made of hard wood to represent iron, the essential thing is to get the proportions correct, no matter what the size of the opening may be. The gate shown was made for a standard door opening, 2 ft. 10 in. by 6 ft. 6 in., and is 2 ft. 10 in. by 6 ft. Open spaces are allowed at top and bottom.

The wood should be well seasoned, clear and straight grained. After the pieces have been cut out, paint them on all sides with two coats of good dead black paint, and when the gate is assembled give it two coats more.

The pickets are ⅞ by 1⅛ in. by 6 ft.; the battens ⅞ by 1⅞ in. by 2 ft. 10 in.; the lock block ⅞ by 9 in. and as wide as the distance between two pickets; the hinge blocks are ⅞ in. thick; the cross strips, which go on the battens at the back after the pickets have been nailed in place, are ⅝ by ¾ in. The cross braces are the same size as these last and should be made of maple or other hard wood, carefully bored for the numerous screws.



Details showing the simple method of making this attractive gate

To insure a lasting job, reject all pieces that are cross grained, checked, or split in the smallest degree. Plane all the pickets to the same thickness. Then hold the six battens together with hand screws or clamps and cut them carefully as shown, all at one time. The pickets must not fit too tightly in the battens or the battens will be bent; yet they must fit snugly to make a workmanlike job. A block for the latch is cut out as shown and fastened in place by four small screws.

Use 1¼-in. screws for the cross strips and braces, wire nails for nailing the battens to pickets, nailing through the front of the battens into the pickets. Obtain three good T- or strap-hinges and a thumb latch to complete the gate.—A. E. ELLING.

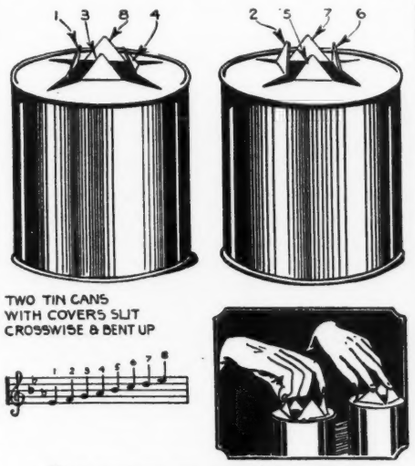
To Remove Small Broken Drills

A GOOD way to remove small drills that have broken off short is to place the piece with the hole in an upright position and put in a drop or two of undiluted muriatic acid every few minutes until the drill becomes free. It will then shake or fall out if the work is tapped with a hammer or struck against the bench. I have never known this method to fail.—R. G. N.

THE HOME WORKSHOP

Wringing Harmony from Tin Cans Is Novel Trick

A CROWD on a street corner attracted my attention and I stopped out of curiosity. An old blind man had seated himself on a folding stool and was taking his paraphernalia from a battered grip—two tin cans and nothing more. After firing up an old briar pipe, he adjusted a can under each of his arms and began to pick with his finger nails at wedges of tin that had been bent up on the can tops. The crowd was held spellbound by a flow



How cans are cut, tuned, and played

of the sweet harmony, which had the tinkling delicacy of an old time music-box, but with a deeper resonance and volume.

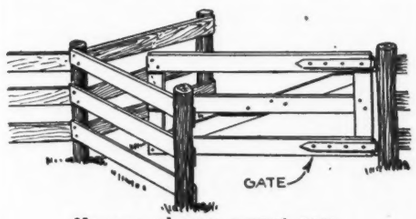
When the player stopped to rest and relight his pipe, I asked him to allow me to examine the tins. They were merely fruit cans, each with two slits across the ends and the four loose V's bent up as shown in the illustration. The height to which they had been turned up determined the pitch of each note. By picking at the points I discovered the sequence to be as shown by the numbers on the diagram.

The chords come in pairs so that three-note chords may easily be played. Two octaves were obtained from the tins because the register change could hardly be distinguished. The points of the wedges had been dulled so as to prevent injury to the fingers.—E. W. DONALDSON.

Farm Gate Is Always Closed to Cattle

OFTEN on the farm there is need of a gate that cannot be left open. This can easily be provided for by making such a one as shown in the illustration.

A person passing through this gate swings it to one side, steps into the V-shaped bay



Horses and cows cannot pass

and pulls the gate back so that there is room for him to pass out at the other side. It is impossible for horses or cattle to get through.—B. H. F.

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THE HOME WORKSHOP

Bell Rings a Warning when Icebox Pan Is Nearly Filled

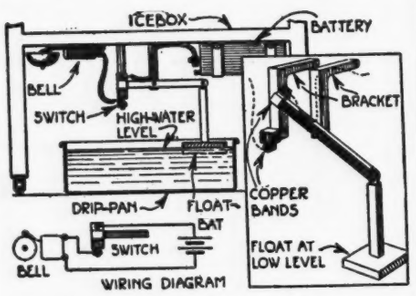
By A. A. Millner

"Best Idea" Second Prize for April

NO further annoyance from having the icebox drip-pan run over will be experienced if a warning electric bell is arranged as shown in the sketch below.

Dry cells and a bell are fastened to the top of the drip-pan compartment, and directly over the center of the pan are secured two wooden angles ½ by 3 by 3 in., spaced 1¼ in. apart. On the bottom of the one nearest the bell is fastened a block ½ in. square by 1 in. long, ½ in. of which projects toward the front of the compartment. A piece of copper band long enough to allow a ½-in. lap is bent around this projection. From it a wire is run to the bell.

For the contact arm use a piece of wood ½ in. square and 6 in. long, with a copper band at one end connected with the batteries. Bore a hole 2 in. from that end, large enough for a ⅞-in. round-head wood screw, allowing a little play. The other end of the stick is rounded and mortised ½ in.



The rising float closes the circuit

to receive the tenon of a stick ½ in. square and 6½ in. long. The joint must be loose.

The float is a block ⅞ in. thick and 3 in. square. In the center cut a hole ½ in. square and ½ in. deep to receive the other end of the upright. These pieces can be fastened together with a nail or screw.

When the pan is empty, the float rests on the bottom of the pan and the contact end of the beam is raised. As the water causes the float to rise, the upper contact is lowered until the water is about 3 in. deep. At that time the contacts close the circuit and the bell rings.

To remove the pan, simply swing the float to the right or left until the top of the pan is cleared.

Reading-Lamp from Auto Parts

A NOVEL reading-lamp may be made from discarded automobile parts. For the shade take an old headlight reflector. The bent neck is a gasoline feed pipe, and the stem of an old valve connects it with a brake rod clevis, which forms the adjustable part.

The clevis is fixed to a section of a spindle arm connecting rod and this passes through a hole drilled in a commutator case. The rod ends in a wooden base. The case and rod are soldered together.—GLEN F. STILLWELL.

The lamp is adjustable

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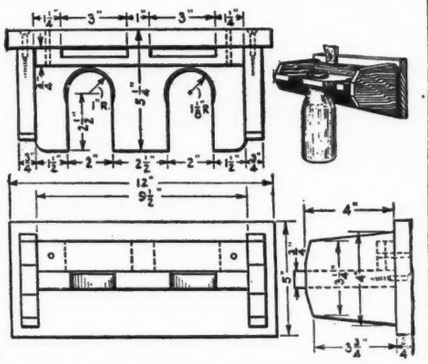
A Milk-Bottle Holder that Is Convenient and Sanitary

WHEN the milkman leaves bottled milk hanging in a holder such as is illustrated, there is no danger of stray cats and dogs trying to get the caps off the bottles. The holder also protects the floor from being stained.

The necks of the milk bottles are slid into circular openings chamfered so that it is impossible for the bottles to fall out. They have to be lifted up a fraction of an inch before they can be pulled out again. A strip



Top, front, and end views of the holder

of wood at the back of the holder provides pockets for tickets, if they are used.

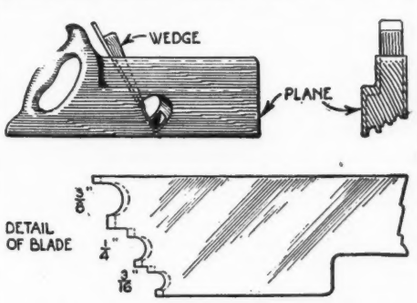
The holder should be made of poplar or any soft wood and painted to match the house. Provision may be made for as many milk bottles as desired.

This problem was worked out in the vocational departments of two of the larger cities of Indiana, and is, I believe, an especially good design for school work, as it provides for a wide variety of accurate tool operations. Students can exercise their own initiative in making different designs for the ends. Best of all, it is something inexpensive to make and yet very useful in the home.—A. S. and E. G. THOMAS.

Triple Bead Plane Saves Space in Carpenter's Tool Box

THIS triple bead plane, which I made for my own use, has proved a handy tool. It has three beads on one cutter, and therefore takes the place of three single bead planes.

The plane is of birch, made from one piece, the handle being shaped out of the



This plane is made from a block of birch and a thin, flat file

solid. The cutter is made from an old thin, flat file. I drew the temper and ground the edge on thin round and flat emery-wheels so as to provide 3/16, ¼ and ⅜ in. beads.—GEORGE HERR.

WANTED IDEAS

Inquiries from Manufacturers and Others Who Are Looking for Good Ideas

PROTECTED BY PATENTS

are constantly being received. Manufacturers are always interested in any new device for which there is a market, which fills a long felt need, which makes production possible at a lower cost, or which will do the work BETTER. Extracts from some of the more recent letters received are printed herewith. There is undoubtedly a great demand to-day for really worth while inventions.

Can You Help?

Here are abstracts from a few recent requests I have received from those who wish to buy, finance or manufacture good inventions. Have you an idea that will fill the bill?

Following is an extract from letter dated July 20, 1921, from a middle western manufacturer whose volume of business last year was approximately $1,000,000. "If you are in touch with any meritorious proposition seeking manufacturing facilities, in the automotive or some other good field, we shall be glad to have you place us in touch with it. We are willing to consider outright purchase of patents or manufacture upon a royalty basis."

Another request from a large corporation, dated June 27, 1921, follows: "Should you have clients whose inventions are worthy of commercial manufacture and exploitation, we shall be glad to consider the financing of such projects, if they are interesting. In that event, we indicate also that we are identified with two large machinery manufacturing plants located, respectively, in Bridgeport, Ct., and Providence, R. I. These plants, besides having their own foundries, are thoroughly equipped to manufacture anything from a small lathe to a complete automobile. Whether your clients have mechanical inventions or otherwise, we shall be pleased to hear of any proposition requiring financing."

Another letter dated April 28, 1921, from a large corporation whose officers include some of the best known men of the country, says in part: "We are in the market for an invention of merit possessing undoubted economic and commercial value combined with ADEQUATE PATENT PROTECTION."

Your First Step

If you have an idea, send immediately for my blank form "TO RECORD YOUR INVENTION." You should serve your own best interests by filling out and signing this form before you disclose your invention TO ANY ONE. This document will help you determine and establish evidence of invention before filing an application in the U. S. Patent Office. A copy, with full instructions, will be gladly sent free on request.

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To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection, and will endeavor to aid him in the commercial development of his proposition—my service is distinguished by over 12 years' successful practice, and by thousands of satisfied clients and by reasonable fees.

Send sketch, or model, and description, for advice as to cost, opinion as to its patentable nature, etc. Preliminary advice gladly furnished without charge.

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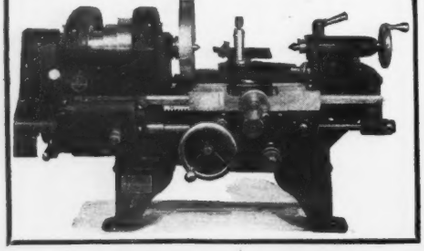

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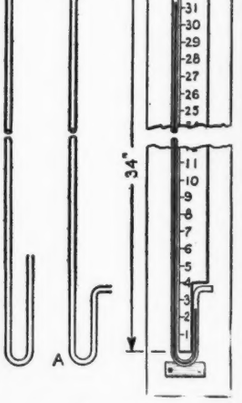
THE HOME WORKSHOP

Mercury Barometer of Scientific Accuracy Costs Little to Make

By B. E. Teachout

MANY of us have had, at one time or another, the desire to own a dependable barometer, but the cost has been prohibitive. This, however, need not deter any one from making an accurate instrument at home. All that will have to be purchased are a few ounces of mercury, a 40-in. length of glass tubing ⅛ or preferably 3/16 in. inside diameter, a yardstick or rule 34 in. long, none of which is expensive.

Seal one end of the glass tubing in the flame of a blowtorch, a bunsen burner, or an alcohol lamp, giving the tube a rolling motion to insure equal distribution of heat. Be sure no minute air openings are left.



Steps in making the instrument

Measure about 34 in. from the sealed end and bend tubing as in the left-hand figure in the illustration. The parallel legs should be about ½ in. apart. To make this bend, about 2 in. of the tubing should be heated uniformly by giving it a combined rolling and lengthwise motion through the flame until the glass is flexible. It may be necessary to heat it more than once to complete the bend. It is advisable to practise bending short pieces of tubing before attempting to bend the long piece, unless you have had previous experience. About 1 in. from the open end of the tube make a right-angle bend, as shown in the middle figure.

To fill the tube, hold it open end up, gather a drop or two of mercury in a fountain-pen filler or medicine dropper, and force it quickly into the tube. It will run down to the curved turn and then continue to the closed end, if the open end is manipulated a little. Air bubbles are to be avoided. If any should form, hold the tube in one hand, closed end down, and gently tap the closed end of the tube against the palm of the other hand, gradually working the bubbles out. Be sure that no air bubbles run up the filled tube when it is being placed in a vertical position.

Repeat the filling process until the tube is filled as far as *A* in the middle figure. There will now be no danger of the mercury running out if the closed end of the tube is held up. Notice if the vertical part of the open tube is half filled with mercury; if not, more mercury should be added. Then plug the open end of the tube with cotton.

Mount the filled tube on a board with sheet-metal clips fastened with screws. Have the top fastener no farther than 8 in. from the top of the closed tube. The block at the bottom is solely for the purpose of

(*Continued on page 105*)

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Making a Mercury Barometer

(*Concluded from page 104*)

preventing the tube from slipping down.

The yardstick should be fitted between legs of the tube in such a way that the gradations shall be adjacent to the longer leg and read upward.

To read the barometer, subtract the height of the mercury in the open tube from the height of the mercury in the closed tube. This will give the atmospheric pressure in inches of mercury. To insure the most accurate results, see that the air bubbles are well worked out and that the instrument hangs exactly vertical. Carefully made, this will prove a most dependable instrument; it will not get out of order and needs no adjustment.

A reading of 28 in. indicates that conditions are favorable for a cyclone; 28¾ in. for a storm; 29¼ in. for rain or snow; 29¾ in. or higher, fair and dry weather. This applies to the lower altitudes; in higher places the corresponding readings will be a little lower. The data for a given locality may be obtained by observation.

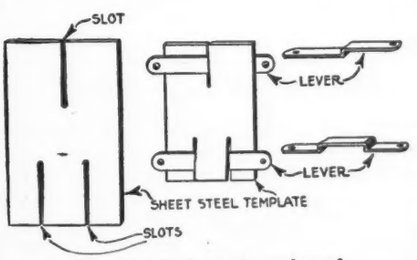
The real usefulness of the barometer in predicting weather conditions comes from observing the direction and rapidity of the mercury's movement. If the mercury falls rapidly and the wind sets in from the northeast, east or southeast, rain or snow may be expected in from 12 to 24 hours. The intensity of the weather disturbance may be estimated by the rapidity with which the mercury falls.

If, conversely, the mercury rises gradually, it means that fair weather is approaching and may be expected in from 12 to 24 hours. A period of little or no change indicates that weather conditions will remain unchanged for about a day more.

Precautions should be taken to hang the instrument where it will not be broken and where it will be protected from rain, snow, and a temperature lower than 39° below zero, as at that temperature the mercury will become solidified and probably break the tube.

Simple Jigs for Bending Sheet Metal Accurately

IN the experimental department of a large adding machine company a simple but accurate method is used for making jigs to bend sheet metal before the dies are made for that purpose. If, for example, it is desired to bend a lever like the lower



How the jig is made and used

one in the accompanying figure, offset for 1 in. to a depth of 1/16 in., the jig is made from sheet metal 1/16 in. thick with two slots 1 in. apart. The lever is slipped into these slots and the jig is then clamped in a vise. The result is a perfect bend 1 in. wide and 1/16 in. deep.

The thickness of the jig determines the depth of the bend. For a ⅛-in. bend, ⅛-in. stock is used.—F. SCHUMACHER.

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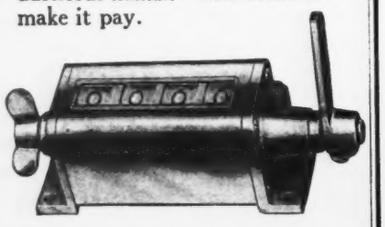

The above Revolution Set-Back Counter records the output of any machine where a shaft-revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list). Smaller counters at prices down to $2.00.

The Hand Tally illustrated below is used for counting anything from number of people attending a ball game, to number of packages in an inventory. In the public place it counts *persons;* in the factory or store it counts *stock;* in the "open" it may count anything from cattle on a ranch, to poles on a telephone line!

Registers one for each pressure of the thumb lever; counts up to 10,000, then repeats. Can be set back to zero from any figure by turning knob once round. Size, exclusive of finger ring, 2 inches greatest diameter. Price, $5.00.

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THE HOME WORKSHOP

Quick Method of Washing Photo Negatives

IF a photographer is in a hurry to wash his negatives, he can use the method illustrated. Place the negative, emulsion side up, on a bottle in the sink directly beneath the faucet and turn on the water. In five minutes the negative will be thoroughly washed.

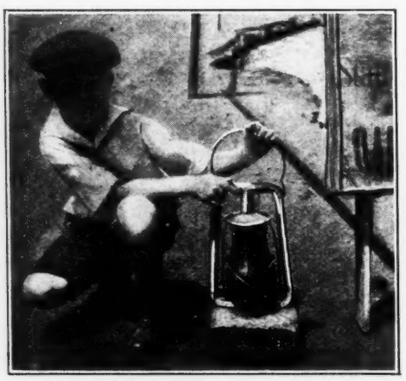
Rinses thoroughly

Films may be treated the same way if a plate of glass is first put on the top of the bottle to support them.—LOUIS GIANCOLA.

Concrete Base for Lantern

WHENEVER it is necessary to use a lantern in a fixed position, it can be made firm and dependable simply by adding a base of concrete.

Make a form of lumber 8 in. square and about 4 in. deep. A portion of the concrete

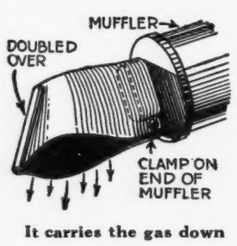


Attached to a base of concrete this lantern will not upset

is poured in the bottom of the form and upon this, in the center, the lantern is placed. Fill the remainder of the form with concrete, completely covering the oil reservoir, but taking care that the oil cap and adjusting screw are above the concrete and easily accessible. A mixture of six parts of sand to one of cement may be used.—ALBERT MARPLE.

Deflector for Ford Muffler

THE end of the muffler, especially on the Ford, projects rearward and the smoke and hot gases issuing from it cover the spare tires, when carried at the rear, also the license-plates and rear lights, with soot.



It carries the gas down

To avoid this, double a sheet of tin or even an old license-plate, cut down into the shape shown, and fasten over the oval opening of the muffler with a bolt. This will carry the gas down and overcome the objections.—A. R.

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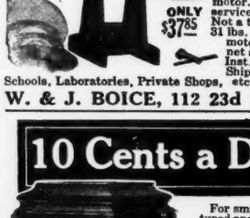

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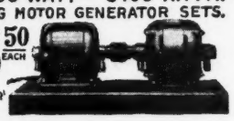

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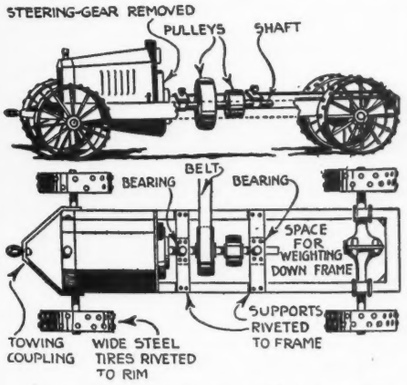
THE HOME WORKSHOP

Converting an Old Car into a Portable Power Plant

EVEN if an automobile is beyond repair in respect to its tires, transmission, rear axle, steering gear and the like, the power plant can often be operated. It may not throttle down or accelerate to the degree required in operating a car, but with some modifications it usually can be converted into a useful and serviceable portable power plant for farm use and building operations.

The modifications consist mainly in the removal of the body, drive-shaft, housing, and transmission. The springs should also be removed and the frame bolted down on the axles. This will make a power plant



Farmers and contractors will find many uses for this machine

more rigid because of the absence of the flexible members and the lowering of the motor closer to the ground. The motor, radiator, and gasoline tank should be left intact.

The wheels are stripped of their flexible tires and are allowed to rest on the rims or wide steel bands are riveted to the wheel felloe so that the machine will roll across soft ground.

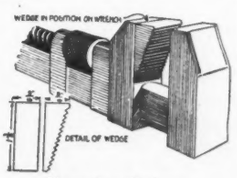
A shaft is secured to the flywheel by means of a belted flange or it is keyed into a drum from the clutch, if of the cone type, and that is secured to the flywheel.

About the middle of the frame one or two pulleys are keyed to the shaft, which is supported by two hangers with suitable bearings. These are held by cross arms solidly riveted to the frame.

When necessary, the frame can be weighed down by means of wooden boxes filled with stone, bags of cement, or scrap iron.—G. A. LUERS.

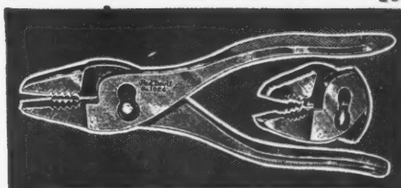
Vest-Pocket Wedge of Steel Extends Use of Wrench

A SMALL wedge made from a piece of steel to the sizes given in the accompanying drawing is useful around the machine-shop or garage. You can utilize the wedge with a monkey-wrench for pipe fittings or for taking off and putting on nuts with a spanner, even if it is a few sizes larger than nut.



For pipe fittings

In making the wedge the teeth can either be milled or filed. The steel should then be carefully tempered.—G. M. ANDERSON.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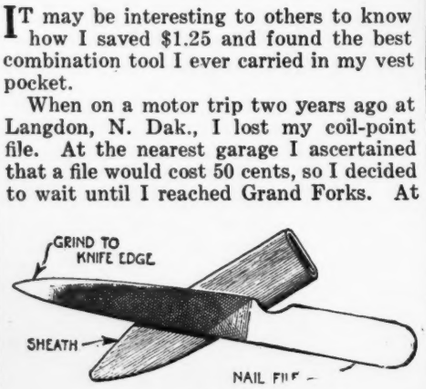
THE HOME WORKSHOP

Cheap Combination Coil-Point File and Penknife

IT may be interesting to others to know how I saved $1.25 and found the best combination tool I ever carried in my vest pocket.

When on a motor trip two years ago at Langdon, N. Dak., I lost my coil-point file. At the nearest garage I ascertained that a file would cost 50 cents, so I decided to wait until I reached Grand Forks. At



One edge of file is sharpened

a store there I bought a 4½-in. nail-file with a little sheath to cover the pointed end when carrying it in the pocket. This cost 15 cents.

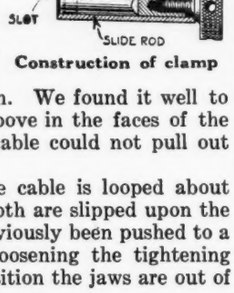
A year later I lost my pocket-knife. Good ones were then expensive and difficult to obtain. Those costing a dollar were so inferior as to be almost worthless. I said to myself that I could not afford to give five bushels of oats for one of them, so, in my shop on the farm, I sharpened one edge of my nail-file on a hand carborundum wheel and an oilstone.

The file now answers every purpose of a penknife, the sheath going on the blunt end to serve as a handle. It is also useful as an office scalpel and paper-knife; the handle end makes a small screwdriver and serves in patching inner tubes. In fact, it is the best small combination tool I have seen anywhere.—E. A. WADSWORTH.

Airplane Cable Splicing Clamp

WHILE employed as a draftsman in the A. E. F., I worked up this clamp for splicing airplane cables. It proved so successful that it may be worth passing on for peacetime uses.

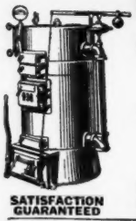
It consists of a block of steel with a hole bored from end to end for a sliding rod. The rod has a pin pressed in one end of a diameter to suit the thimbles used, and the other end is tapped for a tightening screw. Two jaws are made conforming to the shape of the thimbles and mounted so as to rotate on the block as shown. We found it well to make a shallow groove in the faces of the jaws so that the cable could not pull out sideways.



Construction of clamp

In operation the cable is looped about the thimble and both are slipped upon the pin, which has previously been pushed to a free position by loosening the tightening screw. In this position the jaws are out of engagement.

Holding the thimble in place with one hand, screw up the tightening screw with the other hand. The jaws will close of themselves from the pressure of the loop of the cable bearing against the heel of the jaws. Finish clamping by inserting a pin in the tightening screw.—OLIVER L. STEVENS.



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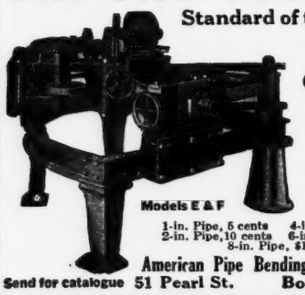

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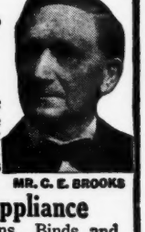

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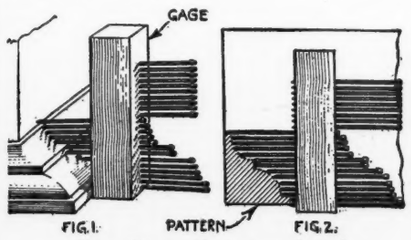
THE HOME WORKSHOP

Homemade Profile Gage for Copying Irregular Shapes

WHENEVER the usual methods of scribing are not feasible, the outlines of moldings and other irregular projections may be copied and transferred by means of a simply made profile gage.

To make this gage, take a strip of maple or other hard wood about ⅞ in. by 1¼ in. and as long as desired. Choose a few wire finishing nails that are as long as the deepest part of the projections that are to be measured added to the width of the holder. Then select a bit or drill that will make a



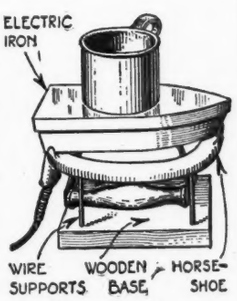
How the profile is transferred

hole a trifle tight for the selected size of nail, but not too tight; it should be possible to push the nail into the hole with the unaided fingers. Bore holes as close together as possible along the center line of the holder, as shown, and put a nail into each hole. Every precaution should be taken to drill the holes perfectly true.

The projection is measured in the manner illustrated and it is obviously a simple matter to transfer the pattern to a cardboard or metal template or directly to the material to be cut or shaped.—A. E. E.

Using the Electric Iron for a Cookstove

TO make a sturdy stand for supporting an electric iron upside down so that it will serve as a small stove, mount a horseshoe of suitable size over a wooden block.



A horseshoe forms the stand

The four supports may be made of short pieces of stiff wire, like telephone wire. One end of each can be forced through the nail holes in the horseshoe and the other driven into the wood. With this stand the iron can quickly be converted into a stove by turning it over and laying it on the horseshoe.—L. B. ROBBINS.

Preserving Eggs for Home Use

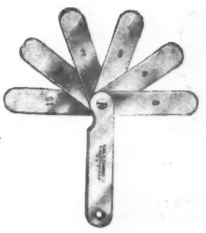
TESTS carried on by the United States Department of Agriculture show that either waterglass or limewater will preserve eggs successfully, and that while waterglass is usually easiest to use and ordinarily gives better results, limewater is much cheaper. Air-slaked lime did not give as satisfactory results as lump lime. The galvanized iron pails were coated with melted paraffin before use with the solution.—B. M.

Starrett Thickness Gage No. 71

Made Especially for the Automobile Mechanic

Contains six leaves particularly adapted for adjusting motor tappets. Also useful for gaging slots. The six leaves have, respectively, thicknesses of .0015, .002, .003, .004, .006, and .015. Auto drivers and mechanics have been looking for this tool.

The combination affords scope for gaging dimensions ranging from .0015 to .031. A neat metal case protects the leaves from kinks, and any leaf may be easily replaced by removing the screw stud on which it is pivoted. An eyelet in the case permits the gage to be carried on a ring or hung from a hook. Extra leaves supplied on order.



Full details of this new Starrett No. 71 Thickness Gage and other new Starrett Tools are given in Supplement to Starrett Catalog No. 22 "W" completely illustrated. Write for copy.

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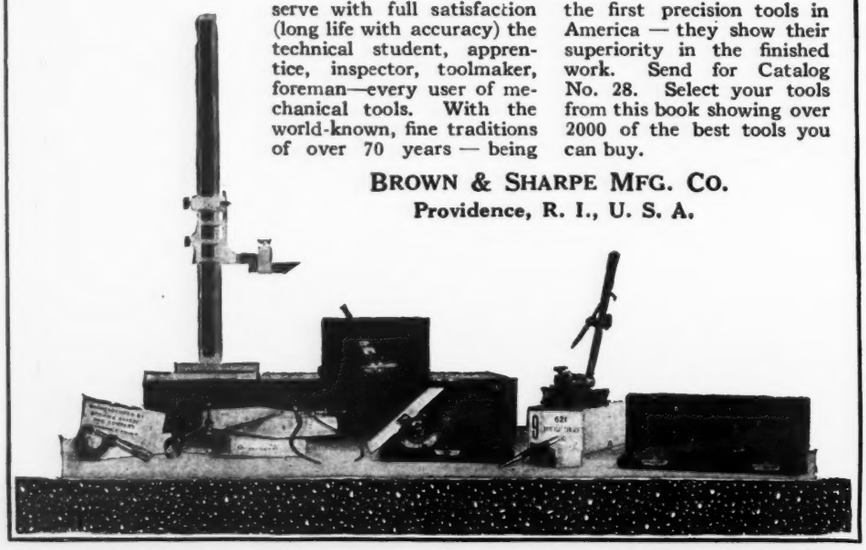

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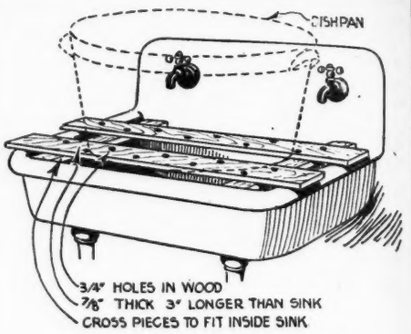
THE HOME WORKSHOP

Save the Housewife's Back with a Sink Rack

THIS article, which I made to lighten my wife's housework, I call a "back saver." Many housewives place the dishpan in the sink when washing dishes and therefore have to bend over, since most sinks are not placed high enough. To remedy this I made a rack that rests on top of the sink and raises the dishpan about



The rack raises the dishpan to the proper height

8 in. The bottom of the pan is then about 31 in. from the floor, about the correct height.

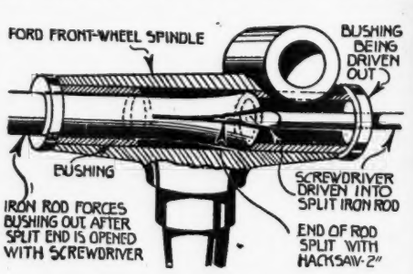
The rack was made for a sink 16 by 28 in. The material used was as follows: Two boards 7/8 by 4 by 30 in. and two strips 7/8 by 1¾ by 15¼ in. In any event, the long pieces should be about 2 in. longer than the sink and the cross pieces a trifle shorter than the inside width.

Although I used yellow pine for this rack, it has not warped in the year it has been in use. Holes bored in the long members will permit the water to run through.—K. W. FLICKINGER.

Removing Spindle Bushings with Split Bolt

A WORTH-WHILE wrinkle for removing spindle bushings can be used on any small spindle, although it is especially adaptable for Ford spindles.

First, obtain a sp ndle bolt or an iron rod of the same diameter and split it down one end with a hacksaw for a distance of about


FORD FRONT-WHEEL SPINDLE
BUSHING BEING DRIVEN OUT
BUSHING
SCREWDRIVER DRIVEN INTO SPLIT IRON ROD
IRON ROD FORCES BUSHING OUT AFTER SPLIT END IS OPENED WITH SCREWDRIVER
END OF ROD SPLIT WITH HACKSAW-2"

Sectional view, clearly showing how method works

2 in. Then drive the bolt into the spindle body opposite the end from which you wish to remove the bushing and thrust a screwdriver into the split. This forces the sides of the bolt apart to such an extent that when pressure is applied to the bolt, the split sides push against the circumference of the bushing and in this manner force it out.

Because of its simplicity this method never fails.—A. SELETZKY.

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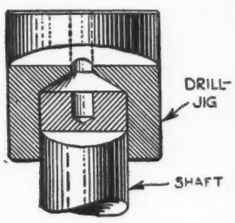
How to Make Accurate Centering Jigs for Small Shafting

FOR the amateurs who do light turning with little metal to spare, and particularly those who turn very light shafting for small models, the following method of centering will prove convenient and economical.



How the jig is used

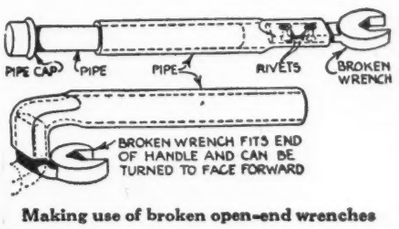
Obtain some short lengths of round, cold rolled steel, the diameter depending on the diameters of the shafts to be centered. Use ½ in. for ¼-in., 5/16-in., and ⅜-in. shafting, and ⅝ in. for 7/16-in. and ½-in. shafting, or whatever sizes are convenient. Cut them into ¾-in. pieces or longer.

Using hermaphrodites or a center square, mark the center and drill right through all the pieces with a 5/32-in. drill. Then drill a little more than half the distance down with the other drills, thus making a convenient set of handy, accurate, self-centering jigs.—R. N. J. PETERS.

Two Good Wrench Kinks

WHEN the handle of an open-end wrench is broken, its days of usefulness are not necessarily ended. It may be made serviceable by one of the methods illustrated.

The head of the wrench may be riveted to a section of pipe, one end of which is flattened, and a variable length extension handle can be added by slipping a smaller pipe, capped on the end, inside the first pipe, as shown in the upper sketch.

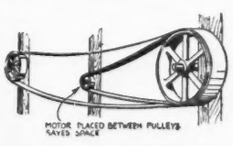


Making use of broken open-end wrenches

In a somewhat similar way a very handy offset wrench with a pipe handle may be made.—CHARLES H. WILLEY.

Double Drive for Limited Space

WHEN space is at a premium and it is necessary to drive two pulleys from a motor, a drive can be arranged as shown in the accompanying diagram.



Another freak drive

In one installation of this type the pulleys are each 2 ft. in diameter, spaced only 8 ft. apart, center to center. The 2-hp. motor drives one pulley, and another pulley on the same shaft drives the third pulley. Because of the amount of slip, this arrangement is objectionable in places where the motor has to be frequently started and stopped.—M. J. S.

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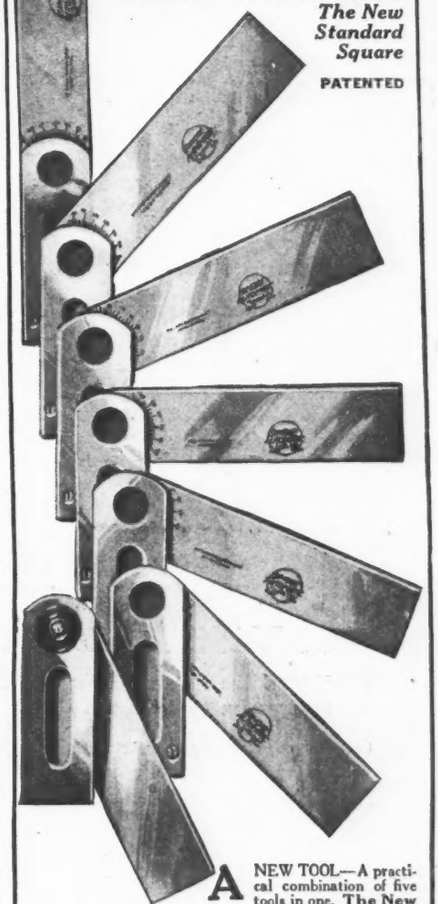

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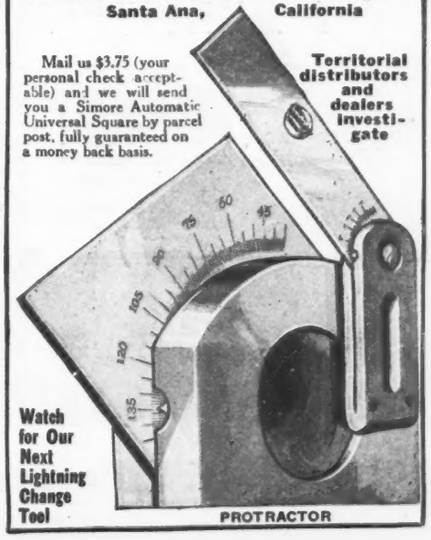

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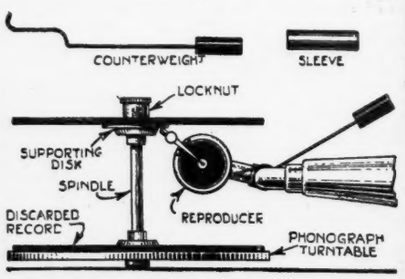
THE HOME WORKSHOP

"Reversed" Phonograph Music Provides Odd Entertainment

DID you ever wonder what your favorite piece of music would sound like if you could hear it sung or played backward? You can find out by making a comparatively simple contrivance to be attached to any talking machine using disk records. This will provide unique guessing games and endless fun for parties.

The device consists of a circular disk, which may be a discarded 10-in. record, to which is attached a wooden spindle, 4 in. long, near the upper end of which is fastened a smaller disk about 2½ in. in diameter, and faced with felt, which serves as the support for the record to be played. The end of the spindle projects ½ in. above the smaller disk, and is threaded to receive a locknut. A metal sleeve 1½ in. long is used to lengthen the gooseneck of the reproducer, and a wire counterweight, 6 in. long and weighted at one end, is used to insure



Counterweight holds reproducer against record, which is upside down

the correct degree of pressure of the needle upward against the record being played.

To use the contrivance, the reproducer is first taken off the gooseneck and the sleeve put on in its place. The reproducer is put on the end of the sleeve, a needle inserted in the usual way, and the reproducer turned so the needle points upward at an angle of about 45 degrees. The disk is put on the turntable of the talking machine just as if it were a record. The record to be played is placed face down on the small disk and is held in place by the nut. The curved end of the counterweight is hooked under the gooseneck close to the reproducer, the wire passing over the other part of the gooseneck and the heavy end pointing backward in line with the swinging arm that carries the reproducer.

The needle is placed in the innermost groove of the reversed record and the record will be played backward.

The effect is astonishing for every musical sound, either vocal or instrumental, is exactly reversed, and familiar words reappear in an unintelligible language never uttered before by human tongue. The music, too, takes on weird and strange transformations. Ballads are turned into modern art songs and such a simple air as "Old Folks at Home" will sound like a grand opera aria. The peculiar quality of the singer's voice remains, but he sings an entirely different song.

When inspiration fails the composer, he has only to put on one of his old pieces and play it backward to discover new and perhaps undreamed-of effects! A piano record when reversed sounds like music on an entirely different instrument, and other musical instruments seem to undergo interesting transformations. Words spoken or sung in English sound like a foreign language.—OLIN A. WILLIAMS.

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